The Cost of Acting "Girly"

Gender Stereotypes and Educational Choices

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Abstract

This paper looks at horizontal sex segregation in education as a factor contributing to gender segregation in the labour market. Economic theories fail to explain why women with the same years of schooling and educational attainment as men are under-represented in many technical degrees, which typically lead to better paid occupations. Following Akerlof and Kranton (2000), I research whether gender identity affects boys' and girls' educational choices and when the gendered pattern appears first. Further, I test the hypothesis that single-sex schools attenuate the influence of gender-stereotypes. I use the *National Pupils Database*, which is a register of all pupils enrolled in state maintained schools in England and I focus on students in lower and upper secondary education. Results from my analysis suggest that gender stereotyping affects educational choices from the age of 14 and this effect is larger for girls than for boys. I also find that attending a sixth-form-single-sex school leads students to a less stereotyped educational choice, after controlling for endogenous self-selection into single-sex schools.

Keywords:gender segregation, educational choices, gender stereotypes, single-sex schools.

JEL codes: I2, J16, J24.

1 Introduction

Earnings differentials between men and women are still pronounced and persistent in European countries. The human capital theory (Becker, 1964;Mincer, 1974;Ben-Porath, 1967) does not offer a satisfactory explanation for the prevalence of men in more prestigious positions and well-paid occupations, as men and women have the same years of schooling and educational attainments.

This paper looks at the horizontal sex segregation in education as a factor contributing to gender segregation in the labour market. Empirical evidence shows that in most of European countries women are under-represented in many technical degrees, e.g. Engineering and Science, whereas they are over-represented in Humanities, Language, Education and Arts (Turner and Bowen, 1999). These gender differences in majors' choice have significant economic impacts (Arcidiacono, 2004) and account for a substantial part of the gender gap in earnings (Brown and Corcoran, 1997).

My paper strongly relies on Akerlof and Kranton's (2000) theoretical approach and it relates to the economic literature studying the role of social identity in determining individual behaviours and gender differences in economic outcomes (Chen and Li, 2009; Benjamin et al., 2010; Delavande and Zafar, 2011). I integrate the concept of gender identity into an economic model of educational choices, to test the hypothesis that students' preferences are largely shaped by notions of gender identity congruence. Students choose they subject specialism according on both their expected monetary returns and the pay-offs in terms of identity,.If a student conforms to the social norms of the reference group defined by gender, she receives an indirect utility, denominated "non-pecuniary pay-off", due to a more rewarding self-image. Conversely, violating the prescriptions of gender identity generates a loss of utility.

I model the students' educational choice as a function of previous attainments to investigate whether students follow their talents in choosing their educational specialism. In particular, I research how students' choice departs from the educational path which maximizes the expected monetary pay-off. Empirical evidences show that the highest pecuniary pay-off is often associated to male segregated careers. While conforming to reference group's social norms might generate a positive utility, girls enrolled in male careers might face a social stigma. The presence of a non-pecuniary pay-off, it might explain why girls do not follow their talents and choose educational careers leading to low-paid job. Therefore, it would help to explain choices which otherwise would be considered detrimental.

Using the National Pupils Database (*NPD*), a register of all pupils in state maintained schools in England, I look at the relationship between grades obtained and subjects' choice during compulsory (14-16 years old) and post-compulsory secondary education (16-18 years old). More specifically, I investigate (i) whether girls and boys follow gender-stereotyped trajectories in education; (ii) whether single-sex schools attenuate gender-stereotypes' influence and educational sex segregation and (iii) when gender stereotypes start affecting educational choices.

Results from my analysis suggest that gender stereotypes affect both girls and boys' educational choices. The influence of gender roles is particularly prominent for girls and it affects their educational choices already at the beginning of secondary education, around age 14. I find that there is a gendered pattern in subject specialism which cannot be explained by gender-specific abilities. In particular girls are more likely to choose the educational option associated with lower pecuniary pay-offs to conform to their gender stereotypes. Finally, according with my results the single-sex schools attenuate the influence of gender stereotypes for both girls and boys.

This paper extends previous literature in various ways. Most of previous empirical works investigating how gender norms affect economic decisions use experimental data. The empirical strategy adopted in the present analysis permits to measure the role of gender identity on student's choice with no experimental data. The advantage of using the *NPD* is that it allows to have a large sample size and to identify the whole population of all students in public educational system in England. Additionally, the longitudinal setting permits to identify when gender stereotypes start affecting educational choices comparing the curriculum choice at 16-18 years old with the choice at 14-16 years old.

Further, previous studies focus on gender gap on specific-subjects or majors choice. In this empirical study, the attempt is to quantify the salience of gender stereotypes already during secondary education when students' choice cannot be studied using a binary choice model, as usually do to model choices at university level. Indeed, in secondary schools the syllabus may include either partially or entirely optional or elective subjects, which implies a wider portfolio choice for students and greater heterogeneity.

Finally, in this paper I move beyond to draw causal inferences about the effectiveness of single-sex environment in alleviating the gender stereotypes influence. Most of previous studies on the effect of attending a single-sex school suffer from biases due to students' self-selection into single-sex schools. I correct for the no-randomness assignment to either single-sex or mixed schools using an endogenous switching regression model. Looking at the effect of single-sex schools on subjects' choice is a further extension of the existing literature on single-sex schooling which in fact investigates predominately students' attainment.

2 Gender Segregation In Educational Choices

2.1 Is It A Matter Of Abilities Or Preferences?

The gender gap in educational choices is markedly persistent. Two main reasons might be suggested: differences in abilities and differences in preferences across gender. In the past, educational gender segregation has been explained by the presence of biological and neurological gender differences. According with this approach, boys use more cortical areas dedicated to spatial and mechanical functioning. Conversely, girls develop more the part of the brain devoted to verbal and emotional functioning. For this reason, girls relatively underperform in technical and quantitative subjects since childhood, which make them gradually disengage from these subjects (Killgore and Yurgelun-Todd 2004; Lenroot, et al. 2007).

However, this approach is not able to explain why girls and boys have different educational preferences even after controlling for years of schooling and attainments. More recently, differences in preferences have been recognized to account for the main part of the unexplained gender gaps in the choice of academic major (Turner and Bowen, 1999). Zafar (2009), using unique experimental data of Northwestern University graduates, find that more than 60 percent of the gender gap in Engineering is due to difference in preferences and beliefs about tastes. Gender gap in risk aversion, competition and differences in attitudes and expectations might explain why boys and girls have different educational preferences. In general, women are found to be more risk adverse than men and are more likely to shy away from competition (Croson and Gneezy, 2009; Gneezy et al., 2003; Niederle and Vesterlund, 2007 and 2010; Datta Gupta et al., 2005). These gender gaps materialize already during childhood and affect boys and girls choices along their lifecycle (Sutter and Rtzler, 2010; Gneezy and Rustichini, 2004).

According with Kurtz-Costes et al.(2008), female educational segregation arises from a process of self-efficacy adjustment. They argue that girls' perception of their own Mathematics and Sciences abilities is lower than for boys. Generally, girls suffer for low self-efficacy particularly on those subjects where they feel more the competition with boys or where obtaining high marks is relatively more difficult (Van de Werfhorst et al., 2003; Wilder and Powell, 1989).

Humlum et al. (2007), using Danish data find that talented students do not necessarily choose careers with high pecuniary pay-off. They go a step further deriving two underlying factors ("career orientation" and "social orientation") to capture individual's identity and they note that these two factors vary systematically with the investments in level and filed of education. They interpret this result as evidence that identity payoffs are an important part of educational decision-making.

Similarly, Noe' (2010) uses a survey on secondary school leavers in Italy and finds that few women enrol into male-traditional field of study at university even if those fields are mostly related with higher paid occupation.

However, to the best of my knowledge none of these works study the salience of gender identity to educational choices. Indeed, most of empirical works on educational choices explore the association between gender and major choices and find sizable gender-based differences. However, none of these works distinguish between the gender gap due either to differences in abilities or gender-conformed preferences.

2.2 Social Interactions, Gender Stereotypes And Conforming Choices

More recently, the economic literature focusing on decision-making process emphasizes preferences and social interaction as determining factors in explaining how individuals make decisions. Part of this literature study the structure of social groups show a tendency of individuals to interact with others with similar characteristics (Marsden, 1988; Akerlof, 1997) and make conforming choices (Cooley, 2006, Sacerdote, 2001). That means that because of social interactions individual decisions are not independent (Manski, 2000).

Zafar (2009) offers an interesting classification of why individuals conform. It might be the case that they conform to the choice of others because they consider that if others made this choice it might be a signal about the goodness of this choice (social learning). Alternatively, they might conform because making the same choice generates a positive utility gain (social comparison) or because if they do not stick to the norm they might pay a disutility related to self-image concerns (social influence).

The last two concepts of social comparison and social influence are the focus of Akerlof and Kranton works (2000, 2002 and 2005). They introduce in the economic analysis the concept of social identity, firstly developed by Tajfel and Turner (1979). More specifically, Akerlof and Kranton (2000) argue that individuals assimilate behaviours and characteristics of the social category they belong to. Individuals obtain a gain in utility from conforming to the choice of their reference group (Cont and Lowe, 2010).

The most prominent division of social category is by gender which naturally divides the society in two subgroups. Under normal circumstances, each person has full control of her own actions, but cannot change the social category's prescriptions by her own. Indeed the society determines the gender norms and ideal behaviours attached to being a woman or a man. Gender specific attributes such as attitude to risk or competition contribute to sketch the gender identity. Arkelof and Kranton argue that "following the behavioural prescriptions for one's gender affirms one's self-image or identity, as a "man" or as a "woman." Any deviation from the expectations of other individuals causes a breach in social norms and generates a sense of guilt and uncertainty. This loss of utility may convince the person to conform (Levine, 1989; Turner, 1991).

In this context, individual choices are the result of simultaneous evaluations of both the pay-off of her actions (pecuniary pay-off) and the indirect utility deriving from self-identification (non-pecuniary pay-off). The latter is positive if individuals' behaviours match with the ideal behaviour within their social category.[1] Especially when individuals feel uncertain on the long-term return of their actions, they might decide to anchor on their actual beliefs and invest on identity, which immediately generate a positive utility.

The return deriving from identifying with a specific group is something subject to change mainly for two reasons. First, the marginal utility of conforming to the social norms of the group (or the stigma caused by a breach of the group's norms) is different when the individual is initiating to be part of that group or is already recognized as part of it. Second, individuals' preferences might change. Indeed, they gain better knowledge of their preferences through experience and by social context or interactions (Grotevant, 1987).

The formation of the self-identity is gradual process from childhood through adolescence (Bnabou and Tirole, 2007). Individuals have an initial endowment of self-identity and prior beliefs and information determined by the social environment. However, the belief about "what kind of a person" is more dynamic during adolescence when the idea of "self" is still in development. Staw (1976) highlights the importance of beliefs and gender stereotypes assimilated during childhood which affects further investments in gender identity during adulthood.

3 Do Students Conform To The Gender Stereotypes?

3.1 Expectations And Preferences

The standard economic theory generally assumes that rational agents choose between different alternatives the one maximizing their expected utility. In this setting, students should choose the major maximizing the expected return of their human capital investment. Typically, the best choice is the one associated with the highest monetary return given the ability constraint.

This approach misses two important elements. Firstly, preferences play a crucial role in the decision making process. As discuss before, preferences account for the biggest part of the variation in educational choices across gender. Second, in making a decision

[1] The non-pecuniary pay-off derives from being member of a group net of the cost faced to fitting in the social category respecting its prescribed characteristics/behaviours.

individuals are influenced by other agents. This is especially true under uncertainty about future pay-off, abilities and preferences.

The theoretical approach used in this paper relies on Akerlow and Kranton's models. Student's utility depends on both the monetary return of the own actions (pecuniary pay-off) and on the indirect utility deriving from self-identification (non-pecuniary pay-off). When considering alternative choices, a female student takes into account what kind of a person each alternative would "make her" and the desirability of those self-views. The "distance" between her behaviour and the ideal prescribed behaviour for girls is a measure of how much she conforms to the "girly" stereotype. The closer the matching is the higher is her non-pecuniary pay-off.

It is worth to point out the distinction between "gender" and "gender identity". Being a girl does not necessarily mean behaving "girly". Gender is an exogenously assigned characteristic. Conversely, gender stereotypes are simplistic generalizations about the gender attributes, differences, and roles of individuals which sketches gender identity. Thus, characteristics such as risk aversion, low competitiveness or low self-efficacy might be considering attributes of the female gender identity as they are more likely to manifest within girls than boys.

The existence of a non pecuniary pay-off associated with the identification with a social category, has been tested. A number of experimental works show how changing the salience of conforming to the reference group behaviour, individual preferences changes.[2]. Obviously, image-related concerns arise only if the individual's actions are observable to other people. However, how much the fear of receiving a social sanction affects the individual behaviour differs from individual to individual and presumably across different social groups.

In the present analysis, differences in preferences across gender explain that part of gender bias in educational choices which cannot be explained by differences in attainments. The main challenge in empirical applications of choice models is that only choices and abilities are observable while both preferences and expectations about the choice-specific outcomes are unknown. In this paper I assume that boys and girls have similar expectations about the monetary return of one educational choice relatively to the other option. By social learning, they are aware that studying Engineering has a higher monetary return than studying Literature.[3] Thus, I test two hypotheses: first, subject-specific abilities cannot explain by themselves differences in educational choices; second, unobserved individual preferences are gender stereotyped. If the first hypothesis is verified, it means that differences in preferences and expectations play a role in educational choices. If the

[2]Benjamin et al. (2009),Chen and Li (2009), Charness et al. (2007); Hoff and Pandey (2006); Delavande and Zafar (2011)

[3]Some experimental evidences suggest it is not an implausible assumption. Comparing subjective expectation data with objective measures, Zafar (2011) found that the subjective data match up well with objective measures. For example, in the case of expected salary in the various majors, students seem to be aware of income differences across majors.

second hypothesis is verified, preferences are heterogeneous by gender, as boys and girls have the same expectations by assumption.

The intuition behind is that two (observably) identical students, a boy and a girl, achieving the same grades at school should choose the same subjects. If only the pecuniary pay-off matters their "optimal" choice is the educational path associated with the highest expected utility given their abilities constraint. Any deviation from the "optimal" choice reflects differences in preferences. The objective is to test if those individual preferences follow a gendered pattern, i.e. if students conform to the most likely choice of their gender group.

3.2 A Model Of Educational Choices And Gender Identity

The presence of a non-pecuniary component in the student's utility function makes possible to explain why high-ability female students ultimately choose educational curriculum leading to low-paying career. If the pecuniary pay-off was the only component of student's utility function, this choice would be considered not rational and ultimately detrimental..

For instance, consider a girl and assume that she is a rational agent willing to maximize her utility. Suppose that Literature is typically considered a "girly" subject, i.e. studied mostly by female students, while Mathematics is a "male" subject, i.e. studied mostly by male students. Consider two possible scenarios. In the first scenario, she is relatively better in Literature than in Mathematics. In this case there is no conflict with respect to what the gender identity prescribes and she should choose according to her skills. Indeed, both the gender identity and the signal she received about her abilities leads her to enrol into more courses of Literature than Mathematics. In the second scenario she is relatively better in Mathematics than in Literature. If she decides to choose accordingly with her abilities, she might bear the cost deriving from the mismatch of her choice with the gender prescribed one. However, she might decide to face this cost and choose Mathematics if she believes that it has a higher return in term of expected monetary pay-off.

I consider the last stage of a three-period educational choice model for students in secondary education aged between 16 and 18. In the first period, students are aged between 11 and 14 and they study the same subjects. At the end of this period, at age 14, they undertake National Curriculum assessments in the three core subjects of Mathematics, English and Sciences, which provides records of attainment in the subjects. In the second period, students are aged between 14 and 16 and they are able to choose within a broad set of subjects. They decide which subjects to study taking into account their abilities, preferences and expectations, normally for a total of ten different courses. Thus, at the end of the second period, they get a grade for each subject studied and gain a better knowledge about both their preferences and abilities. This information guides the student in the selection of the subjects to study in the last two year of secondary education. In the present analysis I model this choice as a function of subjects-specific abilities measured at the end of the second period, controlling for previous attainments in the three core subjects.

The dependent variable defining the subject's choice is a continuous variable (henceforth called *"masculinity score"*) which varies between 0 and 1, with 1 corresponding to a male stereotyped choice, i.e. a choice which is more likely to be made by a boy, and 0 to a female stereotyped choice, i.e. a choice which is more likely to be made by a girl. I use the grades obtained in the second period to compute either the average *grade in male subjects* or the average *grade in female subjects*. The first one is the average grade achieved in the male stereotyped subjects; the second one is the average grade achieved in the female stereotyped subjects. A detailed description of the choice and grades variables is reported in the Section 6.

As said previously, I want to investigate whether boys and girls make different choices all (observably) conditions being equal. I estimate the *masculinity score* at the age 16 through the equations (1) and (2) by *Ordinary Least Squares* (OLS), separately for boys and girls respectively:

$$\begin{gathered} y_i^B = \alpha_0^B b + \alpha_1^B b * mgrade_i + \alpha_2^B b * fgrade_i + \\ \beta_0^B (1-b) + \beta_1^B (1-b) * mgrade_i + \beta_2^B (1-b) * fgrade_i + \\ \Theta^B \mathbf{X}_i + \Phi^B \mathbf{F}_{si} + \epsilon_i^B \end{gathered} \tag{1}$$

$$\begin{gathered} y_i^G = \alpha_0^G b + \alpha_1^G b * mgrade_i + \alpha_2^G b * fgrade_i + \\ \beta_0^G (1-b) + \beta_1^G (1-b) * mgrade_i + \beta_2^G (1-b) * fgrade_i + \\ \Theta^G \mathbf{X}_i + \Phi^G \mathbf{F}_{si} + \epsilon_i^G \end{gathered} \tag{2}$$

where *mgrade* and *fgrade* are respectively the average *grade in male subjects* and the average *grade in female subjects* obtained at the end of the second period, b is a dummy equal to 1 if mgrade is higher than fgrade and is equal to 0 otherwise. The vector $\mathbf{X}_i$ contains a number of control variables that are likely to affect subjects' choice including child's characteristics, family socio-economic background, neighbourhood and school's characteristics and the average attainments achieved in the three core subjects in the first period as a proxy of general cognitive skills.[4] A vector of dummies $\mathbf{F}_s$ controls for fixed effects and unobserved heterogeneity at school level. ϵ_i^B and ϵ_i^G are two normally distributed error terms. Standard errors are corrected for clustering at the school level.

[4]The complete list of control variables is reported in the Table A5 in the Appendix. All variable included in the vector X are either time constant or are measured at the same time of the dependent variable. The only exception is the mean attainments achieved in the first perios.

In the model above students make a choice considering their average grades, mgrade and fgrades, and their relative abilities in one area of study to respect to the others, which is captured by the dummy b. The interactions term between either *mgrade* or *fgrade*, and the dummy b allows distinguishing between the marginal effect of any increase in mgrade and fgrade. In particular, the coefficients $\alpha_1^B \left(\alpha_1^G\right)$ and $\alpha_2^B \left(\alpha_2^G\right)$ represent the change of the *masculinity score* given a marginal change in the grade in male and female subjects respectively, for those boys (girls) who are relatively better in male than female subjects, $(b = 1)$. The coefficients $\beta_1^B \left(\beta_1^G\right)$ and $\beta_2^B \left(\beta_2^G\right)$ are the same elasticities but for boys (girls) who are relatively better in female than male subjects,$(b = 1)$. The parameters α_0^B,α_0^G are the intercepts of the *masculinity score* equation for those boys and girls who are relatively better in male than female subjects and β_0^B,β_0^G for those who are relatively better in female than in male subjects.

For the sake of simplicity let consider only female students. Suppose that girls choose the curriculum only on the basis of their attainments. In this scenario, an increase of the *grade in male subjects* lead them to choose more male subjects in the next period (i.e. if $\alpha_1^G \geq 0$)if they are relatively better in male than female subjects (i.e. if $b = 1$). However, if $b = 0$, their choice is more uncertain. Their choice might be not affected at all by a change in the *grade in male subjects* $\left(\beta_1^G = 0\right)$, given that they might decide to specialize in female subjects given that they are relatively better on them. Conversely, they might decide to increase the number of male subject $\left(\beta_1^G > 0\right)$ if they believe that specializing in a male curriculum is associated with a higher expected monetary return. In any case, they would be presumably less elastic than a comparable girl who is relatively better in male subjects, i.e. $\alpha_1^G > \beta_1^G > 0$.

Similarly an increase in the *grade in female subjects*s, will lead girls to choose more female subjects (i.e. less male subjects). However, by social leaning students know that female specializations are paying less in the job market than male specialization. Presumably, only for those who are relatively better in female than male subjects (i.e. if $b = 0$), the *masculinity score* is going to decrease $\left(\beta_2^G < 0\right)$ as effect of an increase in the *grade in female subjects*. For those girls who have $b = 1$, an increase in the *grade in female subjects* might not affect their choice, i.e. $\alpha_2^G = 0$.

In all scenarios above, students choose according with their talents and there are no reasons to expect significant differences in the predicted parameters for boys and girls. However, there are at least two scenarios in which boys and girls behave differently and attainments do not solely explain their choice. In the first scenario, the boys elasticity to an increase of the *grade in male subjects* is higher than the same elasticity for girls, i.e. $\alpha_1^B > \alpha_1^G \left(or \beta_1^B > \beta_1^G\right)$. It means that if their *grade in male subjects* increases they choose relatively more male subjects than girls in the next period. In the second scenario if their *grade in female subjects* increases girls are more elastic than boys and choose relatively more female subjects, i.e. $\left|\alpha_2^G > \alpha_2^B\right| \left(\left|\alpha_2^G > \alpha_2^B\right|\right)$. In both scenarios girls and boys choose according with their talents but both of them conform relatively more to their reference groups. The non-pecuniary component adds a utility premium to the students' utility function. In other words, their preferences are marginally shaped by notions of gender congruence.

In the extreme case, attainments do not matter at all and the students' choice is completely gender stereotyped. Any change in both the *grade in male subjects* and the *grade in female subjects* would decrease the *masculinity score* for girls, i.e. if $b = 1$ $-\infty \leq \alpha_1^G < 0$ and $-\infty \leq \alpha_2^G < 0$; or if $b = 0$ $\infty < \beta_1^G < 0$ and $-\infty \leq \beta_2^G < 0$. Similarly any change in grades would increase the *masculinity score* for boys, i.e. if $b = 1$ $0 < \alpha_1^G \leq +\infty$ and $0 < \alpha_2^G \leq +\infty$; or if $b = 0$ then $0 < \beta_1^G \leq +\infty$ and $0 < \beta_2^G \leq +\infty$.

4 Does The School's Environment Affect Preferences?

A growing part of literature argues that the school's environment shapes gender identity. According with this literature, mixed-sex settings strengthen gender-stereotypes while students in single-sex school are freer to explore their talents and gender roles fade away. Several empirical studies support this theory showing that girls are more likely to choose male subjects and have higher attainment in them if they are in single-sex classes or in classes with a high share of female students (Mael et al. 2005; Billger, 2002; Rogers and Menaghan, 1991). Tidball (1985 and 1986) find that women in male fields in higher education disproportionally graduated from single-sex colleges. Similarly, Schneeweis and Zweimuller (2009), using Austrian data on students aged 14 years old and enrolled in compulsory school, find that girls are more likely to choose a technical school if in previous grades they attended a school with a higher percentage of female students. Conversely, most of the studies do not find differences either in attainments or educational choices for male students in single-sex or mixed schools. Nevertheless, some authors (Haag, 2000; Stables, 1990) find that boys perform better in languages, reading and writing test in single-sex schools than in mixed schools.

In England, where the tradition of single-sex schools is well established, the Institute of Education (IOE) have conducted a study on a large set of outcomes for students in single-sex and mixed schools. They use data from the National Child Development Study and the British Cohort Studies for two large cohorts of children, born in 1958 and 1970 (Joshi et al., 2010). This study shows that those who went to single sex schools were more likely to study subjects not traditionally associated with their gender and to have more confidence in their ability to do well in these subjects. It also found that at university women who went to girls' schools were more likely than co-educated women to gain qualifications in subjects typically dominated by men, and that both men and women from single-sex schools had a less sex-segregated experience of the labour market. In particular, single-sex schooling improves girls' chances of landing well-paid careers.

Why it does occur is explained by sociologists. Park and Behrman (2010) argue that single-sex schools enhance girls' academic achievement and confidence in academic learning by reducing the influence of adolescence culture and the competition with the other sex. Experimental evidences show that girls from single-sex schools are more likely to enter competition than coeducational girls (Booth and Nolen, 2009). Jackson (2009) argues that: *"in the absence of the opposite sex, the gendered nature of subjects is no longer salient, therefore removing the disutility or stigma associated with particular subjects"*. Similarly the *"theory of proportions"* proposed by Kanter (1977) argues that social pressure and role entrapment affect performance of minority group's members (called *"token group"*) within a population. This group has a higher visibility than the more numerically consistent group which generates a performance pressure and makes readily visible their mistakes and any deviations from prescribed stereotypes. Ultimately, the token group decides to maintain a low-profile to be less visible.

4.1 Self-Selection in Single-Sex Schools

A strategy to isolate the contribution of gender-identity to gender educational segregation is using a quasi-natural experimental approach comparing students in single and mixed-sex schools. In the absence of the other sex, students might be freer to follow their talents departing, if necessary, from their gender role without incurring in any social sanction. If this is the case I would expect to find that girls and boys in single-sex schools are more elastic than co-educated students to any increase in the grade in male and female subjects, respectively.

However, students in mixed and in single-sex schools might be not comparable and concern regarding the internal validity of this approach might be arisen. Presumably, students do not randomly self-select themselves into single-sex schools. In fact, students enrolled in single-sex schools might differ from students in coeducation. For instance, single-sex schools might draw a particular selection of students with stronger motivations and higher expectations or might select their students offering specific curricula, having a specific religious orientation or being more selective in students' admission. The unobservable heterogeneity might affect both the student's school-type participation decision and the subjects' choice. For example, a career-oriented female student might be more likely to choose a single-sex school and, once enrolled, to select a typically male curriculum. In such a case, comparing differences in educational choices between students in single and mixed sex schools via a simple difference in the estimated coefficient of the *masculinity score*, can lead to overstate the true impact of being in a single-sex school on subjects' choice, making difficult to recover the "true" effects of attainments on subjects'choice.

Roy (1951) offers an early discussion on self-selectivity. The econometric discussion has been followed by Gronau (1974), Lewis (1974) and Heckman (1974). Since then, self-selection has been widely discussed.[5] I use the endogenous switching regression model

[5]A complete review of the econometric methods used to solve sample selection and self-selection issue

which allows correcting for both selection biases and unobservable individual heterogeneity in returns in single and mixed schools(Quandt, 1972). In this model the observed outcome (equation 3) derives from two truncated distributions (equation 4 and equation 5):

$$y_i = zy_i^1 + (1-z)\,y_i^0 \tag{3}$$

$$y_i^0 = \alpha_{i0} + \beta_{0v}V_0 + \epsilon_{i0} \qquad if \quad z_i = 0 \tag{4}$$

$$y_i^1 = \alpha_{i1} + \beta_{1v}V_1 + \epsilon_{i1} \qquad if \quad z_i = 1 \tag{5}$$

where y_i^0 is the *masculinity z-score* observed for those students choosing to study in a mixed school ($z_i = 0$); y_i^1 is the *masculinity z-score* of those students choosing to study in a single-sex school ($z_i = 1$); V_0 and V_1 are two vectors of observables characteristics at individual, school and neighbourhood level. Finally, ϵ_{i0} and ϵ_{i1} represent unobserved individual characteristics for those student enrolled respectively in mixed and single-sex schools. The probability to enrol in one or the other school is the outcome of an unobservable latent variable z_i^* following a linear model:

$$z_i^* = \gamma W_i + u_i \tag{6}$$

z_i^* is linked to an observed dichotomous indicator z_i which takes value 1, if $z_i^* > 0$, i.e. the student is enrolled in single-sex school, and 0 if $z_i^* \leq 0$, i.e. the student is in a mixed-sex school. ϵ_i and u_i are assumed to be correlated but independent of (V_0, V_1) and W_i and $E\left[\epsilon_{i0}\,|V_0, z_i, W_i\right] = E\left[\epsilon_{i0}\,|V_0, z_i\right]$ and $E\left[\epsilon_{i1}\,|V_1, z_i, W_i\right] = E\left[\epsilon_{i1}\,|V_1, z_i\right]$. However, the correlation between the error term u_i and the main equations error terms ϵ_{i0} and ϵ_{i1}, implies that the latent variable z_i^* is not independent of ϵ_i and that the ordinary least square estimation of model (4) and (5) would be inconsistent. The error terms ϵ_{i0}, ϵ_{i1}, u_i are assumed to have a trivariate normal distribution with zero mean and covariance matrix:

$$\Omega = \begin{pmatrix} \sigma_u^2 & . & . \\ \sigma_{u0} & \sigma_0^2 & . \\ \sigma_{u1} & \sigma_{10} & \sigma_1^2 \end{pmatrix}$$

where σ_u^2 is the variance of the error term in the selection equation (6), and σ_0^2 and σ_1^2 are the variance of the error terms in the two main equations. Finally,σ_{u0} is the covariance of u_i and ϵ_{i0}, σ_{u1}, is the covariance of u_i and ϵ_{i1}. The sign and value of σ_{u0} and σ_{u1} give the magnitude and the direction of the selection bias. Note that, "σ_{10} is the covariance of the errors ϵ_{i0} and ϵ_{i1} of the two main equations and it is not identified as y_i^0 and and y_i^1 are never observed simultaneously (Maddala 1983).

goes beyond the scope of this paper. Mokhtarian and Cao (2008) provide a recent survey of the more common methodology to address self-selection.

I jointly estimate the main equation and the selection equation allowing for correction between error terms (Lokshin and Sajaia, 2004).[6] The selection equation is estimated by probit regression predicting the probability to enrol in a single-sex school. The main equation is then estimated by a linear regression and the inverse Mill's ratio is included as an additional regressor.

In the endogenous switching regression approach the main equation is estimated separately for single-sex and mixed schools' students.[7] A key advantage of the endogenous switching regression model is that it allows for heterogeneity in the effect of covariates across single-sex and mixed schools' regime. In fact, after accounting for endogenous self-selection, the question remains whether enrolling in a single sex-school should be assumed to have an average impact on subject's choice over the entire sample of students through a shift in the intercept in the *masculinity score* function, or it should be also assumed to have an additional slope effect.

Essentially this model allows a full set of interaction terms between regime status and the control variables included in the model. Presumably, studying in a single-sex might affect how attainments in female and male subjects matter in defining students' choices. The absence of the opposite-sex pressure might cancel out the non-pecuniary component from the students' utility function. In this case students would be completely responsive to any change in grades and there would not significant differences in choice across gender once controlled for abilities.

Even though the endogenous switching model does not strictly require an exclusion restriction, practical experience suggests that it performs poorly if it is not included. A convincing identification of this model requires that at least one variable in W_i is excluded from the main equation (3) (Woodridge, 2002). I use the density of single-sex schools in each *Local Education Authority* (LEA)[8] as an instrument which affects the probability to attend a single-sex school but not directly the curriculum's choice. The implicit assumption is that students reside in the same area where they go to school. Unfortunately, it is not possible to verify it directly because information about students' residence is not available.[9] However, the definition of *LEA* seems to be wide enough

[6]The model can also be estimated following a two-steps procedure. However, I use the full information maximum likelihood (FIML) method, which is recognized to be more efficient although computationally intensive.

[7]The results obtained are very similar to those obtained running a selection model la Heckman twice changing the dependent variable of the selection equation for each of the two regimes considered. However, the switching model is a more convenient approach given that using the la Heckman procedure twice requires two different selection equations, one for each regime. The results are available under request.

[8]A *LEA* is a local authority that has the responsibility for education within its jurisdiction in England. Currently there are 152 local education authorities in England.

[9]According with the UK ment of Education, during the 2007/2008 academic year around 13.8 percent of sixth-form students do not reside in the *LEA* where they attend the school, which is a percentage higher than in Key Stage 3 and Key Stage 4 but still low enough for not representing a problem.(http://www.education.gov.uk/rsgateway/DB/SFR/s000786/index.shtml)

to offer to those students willing to study in a single-sex school the option to choose a single-sex school in the same *LEA* where they live. In fact, in each *LEA* around eight percent of Key Stage 5 schools are single-sex schools and in some *LEA* this percentage rise to 25 percent. Additionally, it is worthwhile to note that the density of single-sex school pass the standard thumb rule of the F-statistics testing the instrument against the null that it is irrelevant in the selection equation estimation.[10] Finally, the estimation of the selection equation confirms that the endogenous variable and the instrument used are positively correlated, and the coefficient is statistically different from zero.

5 Data And Sample Description

The dataset used in the empirical analysis is the *NPD*, an administrative annual register of all pupils in primary and secondary state maintained schools in England. This analysis focuses on students enrolled in the compulsory and post-compulsory secondary education tracks. The Key Stage 2 marks the end of primary education and the beginning of the secondary education. The compulsory secondary education is divided into two Key Stages: Key Stage 3 for students aged 11-14 years, and Key Stage 4 for those aged 14-16 years. After that, students may decide either to leave education or follow in post-compulsory secondary education, commonly denominated sixth form, provided for students aged 16 to 18 years.

As at the end of Key Stage 2, at the end of Key Stage 3 students take the Key Stage 3 National Curriculum tests in English, Mathematics and Sciences. The longitudinal design of this survey allows matching student's prior attainments at Key stage 2 and 3, with later attainments at Key Stage 4 and 5. Assessment of pupils at Key Stage 4 and Key Stage 5 consists on a set of examinations in subjects which students can choose from a range of different subjects.[11] Key Stage 2 National Curriculum tests and Key Stage 4 exams are decide at national level and marked externally. Therefore, they are more reliable than Key Stage 1 and 3 tests and once controlling for unobservable characteristics at schools' level, students' performances is fully comparable across schools.[12]

In this paper, I restrict the sample to the cohort of Key Stage 5 final candidates for the 2007/2008 academic year. As said before, the *NPD* is a census for all population of pupils in state schools. Thus, our sample contains the full population of students of the cohort considered, which counts about 412,000 observations. The students considered are those continuing their studies after compulsory education trough Key Stage 5. Further, I exclude those students enrolling into vocational track and I just consider those

[10] F-statistic is around 73 for girls' switching model and 19 for boys' switching model.

[11] For more information about the English educational system and qualification, see the Section A1 in the Appendix.

[12] Note that following a series of issues regarding the marking, Key Stage 3 National Curriculum assessments were abolished in 2008.

choosing an academic track, i.e. those who at the end of compulsory schooling enter General Certificate of Secondary Education (GCSE) or equivalent. Arguably, the decision to continue into further education or to choose academic qualifications may depend upon characteristics which are not randomly distributed across the population. Unfortunately, I am not able to control for censoring bias because of data limitation. Thus, the results of this analysis are not representative of those students dropping out after compulsory education or enrolled into vocational track. However, my sample remains still representative of about 65 percent the whole population of students at this school age.[13]

Although the *NPD* is primarily an administrative register, it provides a number of variables that help in identifying the main children's characteristics and the household's socio economic background. The *NPD* includes a variable for ethnic origin and the main language spoken at home. Moreover, it includes a variable indicating the student eligibility to receive Free School Meals (*FSM*). This is a federally assisted meal program which subsidy low-income households with nutritionally balanced, low-cost or free lunches for children at school. Finally, the *NPD* includes the *Income Deprivation Affecting Children Index* (*IDACI*), which is an indicator of income deprivation amongst children, capturing the proportion of children experiencing income deprivation in the area of residence.[14] The variable "*Gifted and talented student*" identifies those children who have been recognized by their schools to have an ability to develop to a level significantly ahead of their year group.

In the Table 1, I report the characteristics of the sample of girls and boys used in the estimations. Girls represent around 53 percent of the full sample. In column (3) I report the average difference between girls and boys and a t-test for differences in mean between the two samples. Given the large sample dimension, extremely small and non-notable differences have been found to be statistically significant. Therefore, differences in mean values do not underline substantial differences across gender.[15].

It is worthy to note that the *IDACI* score is about 16 percent which is close to the median value and lower than the mean value of the *IDACI* score in England. Additionally, around 8 percent of students receive a *FSM* at least once during Key Stage 5, which is slightly below the national average of *FSM* beneficiaries in secondary school which is around 10 percent. This suggests that the sample used in this study represents a richer sub-population in comparison to the national average. It is, however, not surprising given that it includes only those students continuing in post-compulsory education. About 18 percent of the sample includes students from ethnic minorities groups and more specifically around 4 percent of Bangladeshi/Pakistani and Indian, 1 percent of Chinese and

[13]For further details, see "Participation in Education, Training and Employment by 16-18 Year Olds in England", Department for Education, http://www.education.gov.uk/rsgateway/DB/SFR/s000938/index.shtml.

[14]For further details, see Table A5 in the Appendix.

[15]Nevertheless, the empirical analysis in the following section is performed separately for girls and boys

Black Caribbean, 3 percent of Black African and 6 percent from other ethnic groups (not included in the analysis). It is important to note that students from ethnic minorities are more likely to enrol in single-sex schools. The high incidence of students from ethnic minorities in single-sex schools might be due to particular religious orientation or segregation phenomenon at school or *LEA* level.

In addition to the *NPD* data, I use data from the *"LEA and School Information Service"* which allow the matching of *LEA* and school comparative information for all public primary and secondary schools in England. It contains a number of information at school level such as the ethnic composition, the percentage of students receiving *FSM*, or having recognized with *SEN*, the percentage of students speaking English as first language. In the Appendix, I report some descriptive statistics for the full list of Key Stage 5 school level variables used in the estimations separately by gender (Table A3a) and by single-sex and mixed school (Table A3b). Remarkably, single-sex schools are more multicultural than mixed schools. Indeed, Whites students represent around 70 percent of students in mixed schools and only 53 percent of students in single-sex schools (Table A3c).

6 Defining Educational Choices And Attainments

As anticipated in previous paragraphs, I define a variable named *masculinity score*, which describes the student's choice. More precisely, the *masculinity score* is a continuous variable measuring how much the subjects' choice of each student reflects the average choice of a typical male student. A high *masculinity score* corresponds to a choice made prevalently by male students; a low *masculinity score* indicates that the curriculum chosen is more likely to be chosen by female studnets. In order to define the *masculinity score*, I aggregate all courses offered at Key Stage 5 in 10 groups of subject areas (Mathematics, English, Sciences, Health, Economics, Humanities, Languages, Arts, Design and Technology, Information and communications technology).[16]

Keeping in mind that at Key Stage 5 students are able to compose their own curriculum, let assume that the student i choose $N_1 = n_1$ courses of $s = 1$, corresponding to Mathematics; $N_2 = n_2$ courses of $s = 2$, corresponding to English; $N_3 = n_3$ courses of $s = 3$, corresponding to Sciences and that $N_s = 0\ s > 3$. The student's curriculum choice can be described by a set of 3 count variables, N_1,N_2 and N_3. Each one of these choices varies in its demand upon the students and each student chooses the curriculum which maximizes the own utility. I define the total *masculinity score* ($Masc$) associated with a student's choice as following:

$$Masc = 1/3\left(\frac{Pr(N_1{=}n_1,boy{=}1|N_1{>}0)_{LEA}}{Pr(N_1{=}n_1|N_1{>}0)_{LEA}} + \frac{Pr(N_2{=}n_2,boy{=}1|N_2{>}0)_{LEA}}{Pr(N_2{=}n_2|N_2{>}0)_{LEA}} + \frac{Pr(N_3{=}n_3,boy{=}1|N_3{>}0)_{LEA}}{Pr(N_3{=}n_3|N_3{>}0)_{LEA}}\right) =$$

$$1/3(Pr(boy = 1\,|N_1 = n_1)_{LEA} + Pr(boy = 1\,|N_2 = n_2)_{LEA} + Pr(boy = 1\,|N_3 = n_3)_{LEA})$$

or is the *partial masculinity score* associated with the choice $N_s = n_s$ for $s = 1, 2, 3$. For instance, the first *partial masculinity score* is defined as the probability that a boy chooses $N_1 = n_1$ courses of Mathematics, over the probability that a random student, studying in a school within the same *LEA*, makes the same choice. This probability is conditioned on selecting Mathematics as a subject area of interest ($N_1 > 0$). Similarly, the other two factors are respectively the *partial masculinity score* associated with the choice of $N_2 = n_2$ courses of English and $N_3 = n_3$ courses of Science.

Let suppose that in the same *LEA* where the student studies, respectively 80, 40 and 20 percent of those choosing $N_1 = n_1$ courses of Mathematics, $N_2 = n_2$ courses of English and $N_3 = n_3$ courses of Sciences are male students.[17] The student's *masculinity score* is therefore $(0.8 + 0.4 + 0.2)/3 = 0.47$. [18]

[16]For the complete list of subjects included in each category see Table A2a in the Appendix.

[17]It is worthwhile to note that given that most of those choosing $N_1 = n_1$ courses of Mathematics are boys, this choice can be considered as a stereotyped male choice, while the opposite is true for the the choice of $N_3 = n_3$ mostly chosen by female students.

[18]Note that given that the *masculinity score* depends not only on individual choices but also on

The *masculinity score* can be defined generalizing the equation above as follow:

$$Masc = \frac{1}{\overline{S}} \sum_{s=1}^{\overline{S}} \left(\frac{Pr(N_s{=}n_s, boy{=}1|N_s{>}0)_{LEA}}{Pr(N_s{=}n_s|N_s{>}0)_{LEA}} \right) =$$

$$\frac{1}{s} \sum_{s=1}^{\overline{S}} Pr\left(boy = 1 |\, N_s = n_s\right)_{LEA} \qquad (7)$$

where $n_s = 1, ..., N_s$ is the number of courses for each type of subject area $s = 1, ..., S$ that the student chooses. The *masculinity score* is a value between 0 and 1, where 1 correspond to a curriculum chosen exclusively by boys and 0 to a curriculum chosen exclusively by girls. Although in this paper I usually omit the subscript i for the sake of simplicity of notation, the *masculinity score* is computed individually for each student i. I standardize the *masculinity score* computing the *z-score* transformation (henceforth called *masculinity z-score*), where the numerator is the difference between the *masculinity score* of the curriculum chosen by student i, and the average *masculinity score* of all students enrolled in the same *LEA*. The denominator is the standard deviation of the *masculinity score* within the same *LEA*:

$$Masc_{zi} = \frac{Masc_i - mean\left(Masc_{LEA}\right)}{sd\left(Masc_{LEA}\right)} \qquad (8)$$

A high *masculinity z-score* indicates a typically male choice. Thus, it indicates a "conformist" choice if the student is a boy or an "anti-conformist" choice if the student is a girl.

The next step is defining how to measure students' performance. In Key Stage 2 and 4 for each course, students' grades are reported on an eight-point scale: A*, A, B, C, D, E, F, U, with U corresponds to fail. I derive a continuous variable converting the alphabetic code to a numeric code from 0 to 7, where the 0 correspond to U and A* to 7. Using all grades received for the courses studied at Key Stage 4, I define two variables for Key Stage 4 attainments: the "*grade in male subjects*" and the "*grade in female subjects*".[19] The first one is the average grade obtained at the end of Key Stage 4 in the courses-per-subject n_s chosen mainly by boys within the same *LEA*.

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schoolmates' choices, it might be the case that two students choosing the same curricula not necessarily end up having the same *masculinity score* if they are studying in different *LEA*.

[19]At Key Stage 4 most students choose at least one typically male and one typically female courses-per-subject pair and thus for them both the *grades in male* and *grade in female subjects* are available. However, respectively for the 7 percent and 11 percent of the students I do not observe either the *grade in male subjects* or the *grade in female subjects*. I call them respectively "*just-male-grades subgroup*" and "*just-female-grades subgroup*". For these two subgroups I impute the missing grades through an imputation procedure detailed in Section A4 in the Appendix. The following analysis includes imputed data. Excluding imputed observations does not change the results.

Conversely, the "*grade in female subjects*" is the average grade obtained at Key Stage 4 in the courses-per-subject n_s chosen mainly by girls. A combination of courses-per-subject must be more likely to be selected by a boy than by a girl to be considered a male n_s,

$$mgrade = \frac{\sum_{n_s=1}^{N_S} grade_{ns}}{\overline{S}} \Leftrightarrow$$
$$Pr\left(boy = 1 \left| N_s = ns\right.\right)_{LEA} \left(boy = 0 \left| N_s = ns\right.\right)_{LEA} \qquad (9)$$

Otherwise it is considered a female and it contributes to the average *grade in female subjects*:[20]

$$fgrade = \frac{\sum_{n_s=1}^{N_S} grade_{ns}}{\overline{S}} \Leftrightarrow$$
$$Pr\left(boy = 1 \left| N_s = ns\right.\right)_{LEA} < Pr\left(boy = 0 \left| N_s = ns\right.\right)_{LEA} \qquad (10)$$

In the previous example, the average grade obtained in $N_1 = n_1$ of Mathematics would be used to compute the *grade in male subjects* given that 80 percent of those students making the same choice are males and only 20 percent are females. Conversely the average grade obtained in $N_2 = n_2$ of English and in $N_3 = n_3$ of Sciences would be used to compute the *grade in female subjects* given that the same choice is prevalently made by female students.

7 What Do Students Choose And How Do Students Perform

Gender identity cannot be observed directly. In order to isolate the effect of gender stereotypes on educational choices, I compare attainments (Table 2) and subjects' choice (Table 3) for boys and girls, and for students in single-sex and mixed schools (Table 5 and 6, respectively).

Table 2 reports the average grade achieved in Mathematics, English and Science during Key Stage 2, and in female and male subjects during Key Stage 4 and 5, separately by gender. During Key Stage 2 the only subjects where girls are better off is English. Conversely, during Key Stage 4 and 5 girls -are consistently better than boys, both in male and female subjects.

[20] The sample is composed by 47 percent of boys and 53 percent of girls. Thus, a courses-per-subject is considered in the computation of the average *grade in male subject* whether more than 47 percent of male students of the same *LEA* chose it. Conversely, it is included in the computation of the average *grade in female subjects*

It is worthwhile to note that during Key Stage 4 girls' attainment in female subjects is slightly higher than their attainment in male subjects and the opposite for boys. The relative advantage of girls in female subjects (and of boys in male subjects) suggests that, if their choice is based exclusively on their abilities, at Key Stage 5 girls should specialize in female subjects and boy in male subjects. As reported in Table 3, the boys' *masculinity z-score* at Key Stage 5 stages is higher than the one of girls. In other words, boys choose relatively more male subjects than girls, and girls choose more female subjects than boys.

However, the gendered patterns in subjects' choice emerge even comparing two students, a girl and a boy, who got the same grades in both female and male subjects. In other words, I consider pairs of "identical" boys and girls and I distinguish between three groups of students: the "Worst Students", the "Medium Students"' and the "Best Students". The worst students achieve the lowest grade in both male and female subjects and the best students the highest.[21] The mean *masculinity score* is computed for each pair (Table 4). Notably, girls and boys with equal attainments make different choices and this happens across all the "identical"-students' sub-sample considered. This suggests that both girls and boys based their choice on elements others than their previous performance. Notably, they both follow their gender stereotypes: girls choose more female than male subjects and the opposite for boys.

As said before, I compare students in single-sex schools and students in mixed school as a strategy to test whether gender identification affects educational choices. The same statistics presented in Table 2 and Table 3, are shown separately for the two school types respectively in Panel A and B of Table 5.

As found previously, girls are always better than boys and relatively better in female than in male subjects, which may explain why the girls' *masculinity score* is always lower in both single and mixed schools. However, girls studying in a single-sex school choose a more male-oriented curriculum. In fact, their *masculinity score z-score* is higher than in mixed schools. It might be the case for two reasons: first, single-sex schools drive a non random selection of students based on curriculum; second, single-sex environment alleviates gender stereotypes.

Supporting the first hypothesis there is the evidence that on average, both boys and girls in single-sex schools are more specialized in male subjects than students in mixed schools. Single-sex schools might offer a more male oriented curriculum than mixed schools. However, the non random self-selection into single-sex school based on curriculum choice does not explain why girls in single-sex school are even more male oriented than boys and why girls studying in a single-sex school make choices more similar to their male schoolmates, as show in Table 6. Considering pairs of identical male and female students as in Table 4, the difference between the *masculinity score* of boys and girls is lower in single-sex than in mixed schools, with the only exception of the worst students' group.

[21]To define the *worst*, the *average* and the *best* students groups, I divide the *grade in female subjects* and the grade male subjects in tertiles.

8 Empirical Analysis Results

The following section reports the results for girls and boys (Section 8.1) and for students in mixed and single-sex schools (Section 8.2). In the last part of this section, the timing of the gender stereotypes' activation is studied comparing choices at Key Stage 5 with the choices at Key Stage 4 (Section 8.3).

8.1 Does Gender Identity Matter? Comparing Female And Male Students' Choices At Key Stage 5

In the Table 7 I report the results for girls and boys who are relatively better in female subjects (first and second columns) and in male subjects (third and fourth columns).[22]The *masculinity score* is estimated using OLS with fixed effects at school's level. Using fixed unobservable effect at school's level (e.g. teachers' characteristics) eliminates any fixed factor that impacts the educational choices of all students within the same school.[23]

I test formally the null hypothesis that the coefficients estimated through OLS are not significantly different from the fixed effects model estimates and I reject the null hypothesis at 1 percent significance level, which confirms that school's unobservable characteristics return into bias coefficients.[24]Additionally, the low value of R-squared for the OLS model constitutes a warning signal of the omission of relevant variables. The R-squared duplicates once schools' fixed effects are used, which confirms that considering school's unobservable characteristics increases the goodness of fit of the model.

The overall results suggest that students respond to an increase of grades choosing more subjects in the area they are improving. The estimated coefficient for the *grade in male subjects* is positive (to an increase of the *grade in male subjects* follows the choice of more male subjects) while it is negative for the *grade in female subjects* (to an increase of the *grade in female subjects* follows the choice of more female subjects, i.e. a decrease of the *masculinity score*).

[22]For the sake of clarity I only show the coefficient and standard error for the main variables. Full results are available on request.

[23]To test the robustness of the *masculinity score* and the grades definition, I estimate the subject choice model using instead of the *masculinity score* the choice of at least two courses in Mathematics and statistics (which can be considered a typical male choice given that among those students doing this choice around 60 percent are boys). Similarly, I compute the average grade got in those Mathematics courses (corresponding to mgrade in the main model) and the average grades obtained in art/humanities courses for those who are choosing two or more coursers within Humanities studies, logic, philosophy, law and sociology (corresponding to fgrade in the main mode given that among those students doing this choice around 65 percent are girls). The results reported in the Table A6a confirm the estimates found using the *masculinity score model* and reported in Table 7.

[24]Notably OLS estimated coefficients are qualitatively equivalent and quantitatively similar to the ones estimated using schools' fixed effect.

Notably, students associate a higher importance to traditionally male subjects which are expected to have better returns in the future. In fact, the marginal effect of an increase in *grade in female subjects* is smaller than the marginal effects of an increase in *grade in male subjects* for all students. This confirms that students perceive education as an investment. Further, the marginal increase of the *masculinity score* due to an increase of the *grade in male subjects* is relatively higher for those who are better in male than in female subjects. The same is true looking at an increase of the *grade in female subjects*, which means that students follow their talents.[25]

However, looking at gender differences, girls' demand of male subjects is less responsive than boys to an increase of the *grade in male subjects*. On average, an increase of one unit of *grade in male subjects* has an effect on *masculinity z-score* bigger for boys than for girls (0.146 and 0.149 standard deviation for boys and 0.083 and 0.126 for girls, within the group of students who are relatively better in female and male subjects, respectively). Apparently, gender identity adds a positive non-pecuniary pay-off to the girls' utility whether they decide specializing in the same-gender stereotyped subject.

Conversely, boys seem choosing according with their abilities and stereotypes play, if any, a marginal role on their choice. Indeed, within those students who are relatively better in female subjects, the increase of one unit of *grade in female subjects* decreases the *masculinity score* for boys more than for girls. Further, the coefficient of the *grade in female subjects* is relatively higher for those who are relatively better in female than in male subjects.

It is worth to highlight that following gender stereotypes have different implications in term of utility maximization for boys and girls. Indeed, if girls follow their stereotypes they might face a cost in term of expected monetary pay-off given that typical female educational path are often associated to low paid occupation. Conversely, if boys conform to the male stereotype they maximize both their non-pecuniary and pecuniary pay-off. For this reason is not possible to say which part of their choice is due to identity or monetary reason, as for girls.

The opportunity cost of conforming to the gender stereotypes might vary according with students' abilities. To allow for non-linearity in the grades' profile, the two continuous variables for grades are split into tertiles (High, Medium and Low grades)[26]and then combined to create nine possible categories of students according with their grades, as reported in the Table 8. This no-linear approach is reliable given the large sample size

[25]These two cases have been described in the theoretical model section (Section 3.2) as the case where $\alpha_1^G > \beta_1^G > 0$ (or $\alpha_1^B > \beta_1^B > 0$) and $\alpha_2^G > \beta_2^G > 0$ (or $\alpha_2^B > \beta_2^B > 0$)

[26]This is done computing dividing the *grade in male subjects* and the *grade in female subjects* by tertiles. The plot of the residuals of the subject choice equation against the two grades suggests the existence of a nonlinear pattern. I use a likelihood ratio test to compare the likelihood of a model containing continuous variable to the likelihood of a model with the variable coded as categorical. For all models estimated I found a significant difference in likelihood which indicates that the linear model would lead to inconsistent estimations.

and allows estimating a more flexible functional form than using a polynomial function.

These nine categories might be grouped in three sub-groups of students[27]the "Best Students" group including those who have high grades in at least one of the two subjects area; the "Medium-Low Students" group including those who have medium or low grades in male and/or female subjects and the "Polarized Students" including those with high grade in one subjects area and low grade in the other one. These three groups represent the 61 percent, 36 percent and 3 percent of the estimation sample, respectively.

The direction of the relation between *masculinity z-score* and grades remains the same once relaxed linearity, which means that a linear representation is still a pretty accurate approximation of the overall relationship. However, the results from linear and the non linear models suggest that the linear model underestimates the effects of grades for the best students.

The results reported in Table 8 suggest that: (i) grades matter more for the best than for the worst students; (ii) the grades' gap between girls and boys is minimum within the best students group; (iii) evidences of gender stereotyped choices show up particularly for girls with low grades or in the polarized group.

The consistent monotonic pattern showed along different level of grades suggests that better students in the opposite-gender stereotyped subjects are more inclined to accept a gender identity loss. For those students, the opportunity cost of renouncing to gender identity is lower than for the worst students. For this reason, girls and boys at the top and bottom of grade distribution behave similarly.

Within the Medium-Low group, boys keep choosing more male than female subjects and the opposite happens for girls regardless of their relative goodness in male and female subjects. The strongest evidences of gendered preferences for girls appear within the polarized group. Girls conform to their gender stereotypes even if they have low grade in the female subjects and high grade in the male subjects. In fact, the estimated coefficient of *grade in female subjects* is negative for girls with high *grade in male subjects* and low *grade in female subjects.*

It is worthwhile to note that studying in a single-sex school has a positive and statistically significant impact on *masculinity z-score* for girls but not for boys (result not reported). This suggests that the girls' cost of behaving against social prescriptions might be reduced by studying in an environment where the gender pressure is lower. This hypothesis is tested in the section below.

[27]HfHm=High *grade in female subjects* (*fgrade*) and High *grade in male subjects* (*mgrade*) MfHm=Medium fgrade and High mgrade; HfMm=High fgrade and Medium mgrade;; MfMm=Medium fgrade and medium mgrade; MfLm=Medium fgrade and Low mgrade; LfMm=Low fgrade and Medium mgrade; LfHm=Low fgrade and High mgrade; HfLm=High fgrade and Low mgrade and LfLm=Low fgrade and Low mgrade.

8.2 Does The School's Environment Matter? Comparing Students' Choices In Single-Sex And Mixed Schools At Key Stage 5

There is large debate in literature about the pros and cons of single-sex schools versus mixed schools. One of the argument pro single sex schools is that single-sex schools seemed more likely to encourage students to pursue academic paths according to their talents rather than their gender stereotypes. Comparing subjects' choices between boys and girls in mixed and single-sex schools helps in identifying if and in which measure abilities and gender roles matter for educational choices.

In the Panel A of Table 9, I report the results of OLS estimation with school fixed effects separately for boys and girls in mixed and single-sex schools. As discussed above, OLS estimates might be biased due to a self-selection problem. In Panel B the *masculinity score* equation is estimated using an endogenous switching regression model to correct for non random selection into single-sex schools. I report both the results from the selection equation and the two main equations corresponding to the *masculinity score* for those students in mixed and single-sex schools. As reported in the selection equation results, studying in a LEA with high density of single-sex schools significantly increases the probability to enrol in a single-sex school.[28]

In the bottom part of the Table 9 I report the correlation coefficients *rho1* and *rho2*, which represent the correlation between the error terms of the selection equation and the subjects' choice equation for students, respectively in mixed and single-sex schools. Both the sign and the statistic significance of these coefficients give interesting insight on the selection issue. *rho2* is positive and significant for all model estimated which suggests that students in a single-sex school share unobserved characteristics leading them to specialize relatively in typically male curriculum than a random student in the sample.

After controlling for self-selection, the endogenous switching regression model substantially confirms the results of the fixed effect estimation. According with my findings studying in a single-sex school attenuates the gender identity salience for both girls and boys. Girls studying in single-sex schools are more likely to choose more typically male subjects. Similarly, boys are less reluctant to choose female subjects. In single-sex schools any change in grades pushes girls to choose more male subjects, whether they are relatively better in male or female subjects. Even if they are better in female subjects, they keep choosing male subjects. Conversely, in mixed schools both attainments in male and female subjects matter to girls' choice. The single-sex environment, reducing the cost of not conforming, makes them freer to think about their future and choose those subjects paying more in the job market.

Similarly, boys take in account in which subjects' area they are performing better to

[28] Conversely, it has not significant effect on the subjects' choice.

choose what to study. If they are relatively better in female subjects, their *masculinity score* decreases if their grade in the female subjects increases. This marginal change is in absolute value higher if they study in single-sex than in mixed schools. However, if they are relatively better in male subjects the increase of their *masculinity score* following an increase of their *grade in male subjects* is lower among boys in single-sex than in mixed schools. Both results suggest that boys studying in single-sex schools are less reluctant to choose more female subjects. Notably, even if they are relatively better in female subjects and studying in single-sex schools alleviates the cost of anti conformist choices, they are not fully specializing in female subjects. The reason why they are still elastic to a change of their *grade in male subjects* might be the higher pecuniary pay-off associated with specialization in male subjects.

8.3 When Do Gender Stereotypes Activate? Comparing Male And Female Students' Choices At Key Stage 4

I investigate when gender identity starts affecting educational choices, looking at the subjects' choice at Key Stage 4. Students choose Key Stage 4 subjects in the last year of Key Stage 3 when they are around 14 years old. Similarly to the Key Stage 5 choices model, the *masculinity z-score* at Key Stage 4 is a function of the attainments at the previous Key Stage controlling for the same set of lagged variables used above. Given the problem of Key Stage 3 assessments comparability, I use Key Stage 2 tests which conversely are national assessments comparable across schools. Thus, once controlled for school unobserved characteristics, the reliability of the comparisons is assured.

Nevertheless, at Key Stage 2, such as at Key Stage 3, students cannot choose the subjects they want to study and they all study the three core subjects: English, Mathematics and Science. For this reason I cannot define the grades variables as I did above. I use instead the average grade in Mathematics and in English, as I did previously to prove the robustness of the *masculinity score* and grades variables' definition.[29]

As for the Key Stage 5 subjects' choice model, I test formally the null hypothesis that the coefficients estimated through OLS are not significantly different from the consistent fixed effects model's estimates and I reject the null hypothesis at 1 percent. Thus, the results reported in Table 10 are including school's fixed effects.

According with my findings, the same patterns observed for Key Stage 5 choice are already present at Key Stage 4. First, notice that attainments matter always more for boys than for girls in determining the subjects' choice at Key Stage 4. In fact, all the

[29]The analogy between Mathematic and English grades with the grade in male and female subjects, respectively, has been proofed to be valid using grade at Key Stage 4. At Key Stage 2, the analogy is granted in the measure that Mathematics and English can be considered a typical male and female subject, respectively. The results for Key Stage 4 reported in Table 10 are fully comparable to the results for Key Stage 5 reported in Table A6a.

grades coefficients are in absolute value higher for boys than for girls. Second, making an anti conformist choice seems to cause a loss of utility for girls but not for boys. Indeed, boys choose their specialization according with their skills. Considering English as a traditionally female subject and Mathematics as a traditionally male subject, at Key Stage 4 boys are not reluctant to enrol in more female subjects if they are good at them. Within those students who are relatively better in Mathematics than in English a marginal increase of the grade in English is increasing the choice of English courses relatively more for boys than for girls. Conversely, girls seem reluctant to follow their talent. An increase of the grade in Mathematics increases the number of Mathematics courses studied at Key Stage 4 always more for boys than for girls.

Therefore, if gender stereotypes affect educational choices already at Key Stage 4, the choice observed at Key Stage 5 might be the results of previous stereotyped choices and investments in term of effort and training on specific subjects. As Staw (1976) argues individuals keep investing to explain to them the initial investment and it may results in the persistence in unproductive tasks. That is why Staw highlights the importance of beliefs and gender stereotypes assimilated during childhood.

In Table 11 I report the *masculinity score* at Key Stage 5 estimated as function of grades at Key Stage 2. The objective of this analysis is to investigate whether Key Stage 5 choices are predetermined already at Key Stage 2 when students are still not able to choose their curriculum. In this case the choice made at Key Stage 5 is unconditional to previous choices and depends uniquely from general abilities showed during primary education or beliefs and stereotypes acquired during childhood.

Early performance and beliefs seem to provide some clues in understanding future educational choices. Among those students who are relatively better in Mathematics than in English at Key Stage 2, a marginal increase of the grade in Mathematics at Key Stage 2 is associated with a higher increment of the Key Stage 5 masculinity choice for boys than for girls. Conversely, among those students who are relatively better in English than in Mathematics, an increase of the grade in English anticipates an increment of the choice in female subjects higher for girls than for boys. Thus, differentials in abilities at Key Stage 2, as happens at later stages, are not able to explain alone the gender gap in educational choices during secondary education. Contrarily to what has been found above, this is true both for boys and girls. It might suggest that boys' propensity to make gender-conforming choices declines over the time. Conversely, girls reinforce their gender stereotypes and stick in investing relatively more in female than male subjects renouncing to a higher monetary pay-off since the beginning of their educational career.

9 Conclusions and Discussion

This paper provides a framework to comprehend why talented girls choose educational careers leading to low-paid jobs. I investigate the existence of a non-pecuniary pay-off associated with gender identity which constrained girls' educational choices and more generally might justify the different educational trajectories of girls and boys. The hypothesis is that gender stereotypes might contribute to the under-representation of women in more technical/quantitative majors which are more likely to lead to better paid and more prestigious position in the labour market.

According with my results, the belief that men are naturally more skilled at technical/quantitative domains is empirically unfounded and attainments are not able to explain alone the subjects' choices. Indeed, boys and girls performing equally in the same subjects, choose differently and according to the own gender stereotype. Boys tend to choose more traditionally male subjects and girls more traditionally female subjects.

Despite of an overtime decline of gender differences on subject choice in England (Wikeley and Stables, 1999; Francis, 2000), I found that gender stereotypes affect educational choices since Key Stage 4, when students have to choose for the first time. In general, boys follow their talents more than girls even if this means make an anti-conformist choice. The gender stereotypes matter relatively more for girls which on the margin might renounce to higher pecuniary returns to follow a stereotyped path.

I find that there is not a monotonic relation between subjects' choice and attainments. An additional unit of *grade in male subjects* increases the male specialization of the best female students more than the others. The better a girl is in traditionally male subjects higher is her incentive to specialize in male subjects. The opportunity cost of choosing differently by the majority of the other female students, is relatively higher for those girls at the bottom of grade distribution than for the best female students. In other, words girls and boys at the top of grade distribution behave similarly.

Furthermore, I find evidences that attending a Sixth form single-sex school alleviates gender stereotypes' influence for both girls and boys. This finding suggests that single-sex contexts foster less stereotypical views of subjects. In the absence of gender pressure, gender stereotypes ease and choices are based mainly on specific abilities.

This research represents a step further in the comprehension on the impact of identity on educational choice. It provides interesting insights in the debate on the origin of gender segregation in education. In order to attenuate the gendered educational segregation, effective policies should be addressed to eliminate what divert students from following their talents. If at the origin of gender segregation there is, as shown, a problem of choices instead of low performance, policies improving either girls schooling or attainments do not result to be effective. Further, as I found that gender issues affects diversely students achieving different levels of performance, policies may worthwhile target different groups of students in a separate way. Finally, according with my results the school's environment plays a crucial role in shaping girls' and boys' educational preferences. The findings about the favourable environment offered by single-sex schools suggest the creation of a gender-friendly environment at school can reduce educational sex segregation.

This analysis shows the existence of gender stereotyped preferences and choices in education and reassure the importance of the learning environment. Further research is needed to study the mechanism generating gender identity and gender-specific preferences in education, such as the development of different expectations and motivation.

Tables

Table 1. Sample description: Comparing girls and boys

	Girls N(216,883)		Boys N(195,021)		Girls-Boys		t test
	Mean	*Std.Dev*	*Mean*	*Std.Dev*	*Mean*	*Std.Dev*	*p-value*
Child's characteristics (ks5)							
Age	16.70	(0.001)	16.75	(0.001)	-0.047	(0.002)	***
White	0.82	(0.001)	0.83	(0.001)	-0.008	(0.001)	***
Bangladeshi/Pakistani	0.04	(0.000)	0.04	(0.000)	0.001	(0.001)	*
Chinese	0.01	(0.000)	0.01	(0.000)	-0.001	(0.000)	**
Indian	0.04	(0.000)	0.04	(0.000)	-0.003	(0.001)	***
Caribbean Black	0.02	(0.000)	0.01	(0.000)	0.005	(0.000)	***
African Black	0.03	(0.000)	0.02	(0.000)	0.004	(0.001)	***
Others	0.06	(0.001)	0.06	(0.001)	0.002	(0.001)	***
First language: English	0.88	(0.001)	0.88	(0.001)	-0.004	(0.001)	***
Gifted & Talented student	0.22	(0.001)	0.21	(0.001)	0.008	(0.001)	***
SEN	0.05	(0.001)	0.09	(0.001)	-0.028	(0.001)	***
Socioeconomic Status (ks5)							
IDACI	0.17	(0.000)	0.16	(0.000)	0.010	(0.001)	***
FSM	0.08	(0.001)	0.07	(0.001)	0.009	(0.001)	***
Single-sex school							
Enrolled in ks3	0.15	(0.001)	0.12	(0.001)	0.036	(0.001)	***
Enrolled in ks4	0.20	(0.001)	0.15	(0.001)	0.052	(0.001)	***
Enrolled in ks5	0.15	(0.001)	0.13	(0.001)	0.03	(0.001)	***

*Note: SEN= Special Educational Needs; IDACI= Income Deprivation Affecting Children Index; FSM=Free School Meals Eligibility; ks3, ks4, ks5= k-stage 3, 4 and . Asterisks indicate significance at * 0.1 ** 0.05 *** 0.01 levels, respectively.*

Table 2. Attainments at k-stage 3,4 and 5

	Girls		Boys		
	Mean	*Std.Dev*	*Mean*	*Std.Dev*	*Obs.*
Grades at ks2					
Math	72.15	(0.037)	75.85	(0.039)	361,501
English	70.03	(0.025)	67.16	(0.027)	361,141
Science	63.84	(0.021)	64.99	(0.022)	361,066
Grades at ks4					
Female subjects	4.95	(0.002)	4.68	(0.003)	381,450
Male subjects	4.91	(0.003)	4.74	(0.003)	389,390
Grades at ks5					
Female subjects	3.20	(0.003)	3.02	(0.004)	307,890
Male subjects	3.23	(0.004)	3.04	(0.004)	244,908

Note: ks2=k-stage2, ks4=k-stage4, ks5= k-stage 5

Table 3. Masculinity score in k-stage4 and k-stage 5

	Girls		Boys		
	Mean	*Std.Dev*	*Mean*	*Std.Dev*	*Obs*
Masculinity score					
Key stage 4					
Average score	0.460	(0.000)	0.470	(0.000)	395,339
Z-score	-0.340	(0.002)	0.300	(0.002)	395,339
Key Stage 5					
Average score	0.450	(0.000)	0.470	(0.000)	363,416
Z-score	-0.350	(0.002)	0.370	(0.003)	363,416

Note: ks4, ks5= k-stage 4 and 5

Table 4. Average masculinity score by gender: Identical boys and girls having the same k-stage 4 grades in both female and male subjects

	Average masculinity score				
	Girls		Boys		
	Mean	*Std.Dev*	*Mean*	*Std.Dev*	*Obs.*
Worst Student	1.59	(0.004)	1.98	(0.004)	59,988
Average Student	1.66	(0.004)	2.16	(0.005)	54,057
Best Student	1.98	(0.004)	2.39	(0.004)	84,468

Note: Using a sub-sample of students who got the same grades in both female and male subjects. *Worst students, Medium Students* and *Best Students* groups are defined on the base of their grades and corresponds to the bottom, medium and top grades tertiles.

Table 5. Grades at k-stage 4 (Panel A) and masculinity score at k-stage 5 (Panel B) comparing students in single-sex and mixed schools at k-stage 5

Panel A

	Grades (Key Stage 4)									
	Mixed schools					**Single-sex schools**				
	Girls		Boys			Girls		Boys		
	Mean	*Std.Dev*	*Mean*	*Std.Dev*	*Obs*	*Mean*	*Std.Dev*	*Mean*	*Std.Dev*	*Obs*
In Female subjects	5.06	(0.003)	4.81	(0.004)	171,593	5.50	(0.006)	5.33	(0.007)	51,239
In Male subjects	5.03	(0.004)	4.88	(0.004)	176,319	5.52	(0.006)	5.46	(0.007)	54,899

Panel B

	Masculinity score (Key Stage 5)									
	Mixed schools					**Single-sex schools**				
	Girls		Boys			Girls		Boys		
	Mean	*Std.Dev*	*Mean*	*Std.Dev*	*Obs*	*Mean*	*Std.Dev*	*Mean*	*Std.Dev*	*Obs*
Average score	0.45	(0.000)	0.47	(0.000)	179,595	0.46	(0.000)	0.47	(0.000)	56,452
Z-score	-0.35	(0.003)	0.37	(0.003)	179,595	-0.22	(0.005)	0.40	(0.007)	56,452

Table 6. Average masculinity score by gender and school's type: Identical boys and girls having the same k-stage 4 grades in both female and male subjects

	Average masculinity score (Key Stage 5)						
	Girls		**Boys**		**Girls-Boys**		
	Mean	*Std.Dev*	*Mean*	*Std.Dev*	*Mean*	*Std.Dev*	*Obs.*
Mixed schools							
Worst Student	1.60	(0.006)	1.99	(0.006)	-0.39	(0.008)	29,300
Average Student	1.67	(0.006)	2.17	(0.007)	-0.50	(0.009)	27,239
Best Student	1.94	(0.005)	2.42	(0.006)	-0.47	(0.008)	42,338
Single-sex schools							
Worst Student	1.58	(0.017)	1.99	(0.019)	-0.41	(0.025)	3,885
Average Student	1.77	(0.013)	2.13	(0.015)	-0.36	(0.020)	6,606
Best Student	2.15	(0.007)	2.41	(0.008)	-0.26	(0.011)	22,584

Note: Using a sub-sample of students who got the same grades in both female and male subjects. *Worst students, Medium Students* and *Best Students* groups are defined on the base of their grades and corresponds to the bottom, medium and top grades tertiles.

Table 7. Subjects' choice at k-stage 5: Compare students relatively better in male or female subjects by gender, OLS with fixed effect at school level results

K-stage 5 Masculinity z-score: OLS with fixed effect at school's level				
	Relatively better in female subjects		**Relatively better in male subjects**	
	Girls	**Boys**	**Girls**	**Boys**
Grade (k-stage 4)				
In male subjects	0.083***	0.146***	0.126***	0.149***
	(0.010)	(0.013)	(0.011)	(0.013)
In female subjects	-0.042***	-0.083***	-0.028**	-0.028**
	(0.012)	(0.015)	(0.011)	(0.013)
Constant	-2.053***	-0.663***	-2.274***	-0.892***
	(0.150)	(0.164)	(0.151)	(0.162)
Adj. R-squared	0.09	0.10	0.09	0.10
Observations	70187	63019	70187	63019

*Note: All control variables included. Standard error accounts school-level clustering (reported in parenthesis). Asterisks indicate significance at * 0.1 ** 0.05 *** 0.01 levels, respectively.*

Table 8. Subjects' choice at k-stage 5: compare the Best Students with the Worst ones, OLS with fixed effect at school level results

K-stage 5 Masculinity z-score: OLS with fixed effect at school's level				
	Girls		*Boys*	
	Coef.	*Std.Err.*	*Coef*	*Std.Err.*
Best students				
HfHm*mgrade	0.267***	(0.024)	0.138***	(0.027)
HfHm*fgrade	0.077***	(0.024)	-0.041	(0.028)
MfHm*mgrade	0.101***	(0.035)	-0.008	(0.041)
MfHm*fgrade	0.081	(0.050)	0.212***	(0.058)
HfMm*mgrade	0.070	(0.046)	0.100*	(0.057)
HfMm*fgrade	0.146***	(0.035)	-0.087*	(0.049)
Medium-Low students				
MfMm*mgrade	0.119***	(0.032)	0.174***	(0.040)
MfMm*fgrade	0.107***	(0.034)	-0.007	(0.045)
LfMm*mgrade	0.039	(0.045)	0.059	(0.048)
LfMm*fgrade	0.075**	(0.031)	0.036	(0.030)
MfLm*mgrade	-0.018	(0.023)	-0.016	(0.027)
MfLm*fgrade	0.059	(0.043)	0.011	(0.057)
Polarized students				
LfHm*mgrade	-0.033	(0.091)	-0.061	(0.087)
LfHm*fgrade	-0.075	(0.079)	-0.005	(0.095)
HfLm*mgrade	-0.006	(0.060)	0.040	(0.079)
HfLm*fgrade	0.235***	(0.073)	0.076	(0.102)
Adj. R-squared	0.09		0.10	
Observations	70187		63019	

*Note: All control variables included. Standard error accounts school-level clustering. Mgrade=grade in male subjects; fgrade=grade in female subjects. Asterisks indicate significance at * 0.1 ** 0.05 *** 0.01 levels, respectively.*
Grade groups: HfHm=High grade in female subjects (fgrade) and High grade in male subjects (mgrade); MfMm=Medium fgrade and medium mgrade; LfLm=Low fgrade and Low mgrade; MfHm=Medium fgrade and High mgrade; LfMm=Low fgrade and Medium mgrade; LfHm=Low fgrade and High mgrade;HfMm=High fgrade and Medium mgrade; MfLm=Medium fgrade and Low mgrade; HfLm=High fgrade and Low mgrade.

.

Table 9. Subjects' choice at Key Stage 5: School fixed effect and endogenous self-selection model

PANEL A

	Masculinity z-score (Key Stage 5): OLS with fixed effect at school's level							
	Relatively better in female subjects				**Relatively better in male subjects**			
	Girls		**Boys**		**Girls**		**Boys**	
	Mixed schools	*Single-sex schools*	*Mixed schools*	*Single-sex schools*	*Mixed schools*	*Single-sex schools*	*Mixed schools*	*Single-sex schools*
Grades (Key Stage 4)								
In male subjects	0.071***	0.153***	0.142***	0.175***	0.139***	0.058**	0.149***	0.147***
	(0.011)	(0.030)	(0.014)	(0.041)	(0.012)	(0.028)	(0.014)	(0.034)
In female subjects	-0.045***	-0.035	-0.086***	-0.076*	-0.050***	0.095***	-0.033**	0.005
	(0.013)	(0.033)	(0.016)	(0.045)	(0.012)	(0.029)	(0.014)	(0.038)
Constant	-2.063***	-2.072***	-0.947***	-0.787	-2.313***	-2.191***	-1.185***	-1.009**
	(0.163)	(0.378)	(0.167)	(0.484)	(0.164)	(0.379)	(0.165)	(0.478)
Adj. R-squared	0.09	0.10	0.11	0.09	0.09	0.10	0.11	0.09
Observations	58496	11691	53948	9071	58496	11691	53948	9071

*Note: All control variables included. Standard error accounts school-level clustering (reported in parenthesis). Asterisks indicate significance at * 0.1 ** 0.05 *** 0.01 levels, respectively.*

PANEL B

	Masculinity z-score (Key Stage 5) :endogenous self-selection model											
	Relatively better in female subjects						**Relatively better in male subjects**					
	Girls			**Boys**			**Girls**			**Boys**		
	Selection in single-sex schools	*Mixed schools*	*Single-sex schools*	*Selection in single-sex schools*	*Mixed schools*	*Single-sex schools*	*Selection in single-sex schools*	*Mixed schools*	*Single-sex schools*	*Selection in single-sex schools*	*Mixed schools*	*Single-sex schools*
Grades (Key Stage 4)												
In male subjects	0.188***	0.079***	0.165***	0.129**	0.138***	0.154***	0.112**	0.141***	0.037	0.143***	0.144***	0.121***
	(0.043)	(0.011)	(0.030)	(0.058)	(0.014)	(0.042)	(0.048)	(0.012)	(0.027)	(0.049)	(0.014)	(0.035)
In female subjects	0.055	-0.049***	-0.049	0.158**	-0.078***	-0.086*	0.159***	-0.043***	0.118***	0.193***	-0.017	0.015
	(0.047)	(0.013)	(0.033)	(0.072)	(0.017)	(0.044)	(0.045)	(0.012)	(0.029)	(0.051)	(0.014)	(0.039)
Density of single-sex schools (LEA)	8.009***	.	.	7.783***	.	.	8.009***	.	.	7.783***	.	.
	(1.178)	.	.	(1.068)	.	.	(1.178)	.	.	(1.068)	.	.
Constant	-3.401***	-2.063***	-1.941***	-5.703***	-0.983***	-0.402	-3.593***	-2.344***	-2.104***	-5.992***	-1.262***	-0.682
	(0.773)	(0.171)	(0.400)	(0.915)	(0.183)	(0.532)	(0.747)	(0.171)	(0.383)	(0.881)	(0.182)	(0.553)
Observations	70174			63011			70174			63011		
Selection tests												
rho1	-0.026			-0.108*			-0.026			-0.108*		
rho2	0.111*			0.221***			0.111*			0.221***		

*Note: All control variables included. Standard error accounts school-level clustering (reported in parenthesis). Asterisks indicate significance at * 0.1 ** 0.05 *** 0.01 levels, respectively.*

Table 10. Subjects' choice at k-stage 4: OLS with school's fixed effects, by gender

Masculinity z-score (Key Stage 4): OLS with fixed effect at school's level				
	Relatively better in English		**Relatively better in Mathematics**	
	Girls	*Boys*	*Girls*	*Boys*
Grades (Key Stage 2)				
Mathematics	0.002***	0.000	0.005***	0.007***
	(0.000)	(0.001)	(0.000)	(0.000)
English	-0.004***	-0.003***	-0.005***	-0.007***
	(0.001)	(0.001)	(0.000)	(0.000)
Constant	-2.237***	-1.471***	-2.365***	-1.603***
	(0.125)	(0.142)	(0.125)	(0.139)
Adj. R-squared	0.18	0.20	0.18	0.21
Observations	133719	115842	133719	115842

*Note: All control variables included. Standard error accounts school-level clustering (reported in parenthesis). Asterisks indicate significance at * 0.1 ** 0.05 *** 0.01 levels, respectively.*

Table 11. Subjects' choice at k-stage 5 is already predetermined at k-stage 2? OLS with school's fixed effects

Masculinity z-score (Key Stage 5): OLS with fixed effect at school's level				
	Relatively better in English		**Relatively better in Mathematics**	
	Girls	*Boys*	*Girls*	*Boys*
Grades (Key Stage 2)				
Math	0.004***	-0.005***	0.027***	0.029***
	(0.001)	(0.001)	(0.001)	(0.001)
English	-0.013***	-0.005***	-0.026***	-0.027***
	(0.001)	(0.001)	(0.001)	(0.001)
Constant	-1.060***	0.254	-1.724***	-0.381**
	(0.146)	(0.171)	(0.142)	(0.159)
Adj. R-squared	0.14	0.16	0.01	0.16
Observations	69086	62170	69086	62170

*Note: All control variables included. Standard error accounts school-level clustering (reported in parenthesis). Asterisks indicate significance at * 0.1 ** 0.05 *** 0.01 levels, respectively.*

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A1. English educational system

The English educational system is divided in primary education, compulsory secondary education and post-compulsory secondary education as showed in Figure 1. After secondary education students may apply to higher education institutions/universities.

English educational system

	Compulsory education												Further education						
Age	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Yea	1	2	3	4	5	6		7	8	9	10	11	12	13					
	K-stage 1			K-stage2				K-stage3			K-stage 4		K-stage5		Higher education				
	Primary education							Secondary education											
								Lower sec.			Upper sec.								

In England, education is mainly provided by maintained (i.e. public schools, including community schools, foundation schools, voluntary aided schools and voluntary controlled schools.), while 7 per cent of the school age population enrol into independent schools (private schools). In general, no charge may be made for education provided for pupils in maintained schools. Conversely, most independent schools are financed by means of fees paid by parents or donations and grants received from benefactors.

The primary school normally has seven year groups and comprises two k-stages, k-stage 1 and k-stage 2 (pupils aged five to seven, and seven to 11, respectively). In these two k-stages all students study three compulsory/core subjects: English, Mathematics, science plus some core subjects. After primary education, students accede to secondary education. The first five years of secondary education, pupils aged 11 to 16 years of age, fall within the period of compulsory education and the last two year of post-compulsory full-time secondary education are usually denominated sixth form. The compulsory secondary education is divided into two key stages, k-stage 3 catered for pupils aged 11–14 years and k-stage 4 for those aged 14–16 years. After that, students may decide either to leave education or follow in post-compulsory secondary education provided for pupils aged 16 to 18 years..

K-stage 3 is commonly known as lower-secondary education and k-stage 4 and k-stages 5 as upper-secondary education. During upper-secondary education students may choose subjects leading to academic or vocational certificates. Vocational qualifications are intended to offer a comprehensive preparation for employment, as well as a route to higher-level qualifications. Generally, those students studying vocational subjects at k-stage 4 are more likely to drop out of school with the end of compulsory education, although k-stages 5 offers a wide range of vocational subjects. Those students choosing a more academic curriculum are more likely to go to post-compulsory education and higher education.

At the end of k-stage 3 students take National Curriculum tests in English, Mathematics and Science. Assessment of pupils at k-stage 4 is normally by the *General Certificate of Secondary Education* (GCSE) which consists of a range of examinations in single subjects. A certificate is issued listing the grade which a candidate has achieved in each subject attempted. The results are reported on an eight-point scale: A*, A, B, C, D, E, F and G. Candidates who fail to reach the minimum standard for grade G are recorded as ‘U’ for ‘unclassified’ and do not receive a certificate. In June 2008, the Secretary of State for Children, Schools and Families launched the National Challenge. This is a programme of support to secure higher standards in all secondary schools so that, by 2011, at least 30 per cent of pupils in every school will gain five or more GCSEs at grades A* to C, including both English and Mathematics.

Since 2002 *General Certificates of Secondary Education in vocational or applied subjects* (*GCSEs*) have been available. Applied GCSEs were previously known *as General National Vocational Qualifications* (GNVQs), which were withdrawn gradually between 2005 and 2007. During k-stage 5, students may take a number of courses leading to approved qualifications, including *General Certificate of Education Advanced-level (GCE A-level)* qualifications, *GCE Advanced Subsidiary qualifications* (*GCE applied AS level*) *and A-levels in applied subjects* (GCE *applied A-level*). All these qualifications are acceptable for entry into higher education. Note that, *GCE in applied subjects (A and AS levels)* were previously called *Vocational Certificate of Education (A and AS level).* These qualifications phased out during the academic year 2007/2008 and replaced by the new qualifications from 2008/2009 onwards. In the present analysis students studying for vocational qualifications have been excluded.

Most secondary schools which are maintained schools are non-selective and accept pupils regardless of ability. These are known as comprehensive schools. In some areas of England there are also schools which select their pupils by ability and are commonly known as grammar schools. Additionally, there are no official qualifications required for admission to the sixth form of a secondary school, but schools generally set their own admissions requirements. Schools commonly ask for a minimum of five GCSE passes at grades A*– C for admission to GCE A-level courses. Criteria for admission to GCE A-level courses also often include the achievement of good GCSE passes (usually grade C or above) in the subjects to be studied at GCE A-level.

A2. Subjects and curriculum composition

Table A2a. Subjects' categories S considered

	Grade achieved at				Grade achieved at		
Subjects	GA	GAS	GAD	**Subjects**	GA	GAS	GAD
Mathematics				**Languages**			
Mathematics	x	x		Welsh	x	x	
Mathematics (Mechanic)	x	x		Dutch	x	x	
Mathematics (Pure)	x	x		French	x	x	
Mathematics (Discrete)	x	x		German	x	x	
Mathematics (Applied)	x	x		Italian	x	x	
Mathematics (Statistics)	x	x		Modern Greek	x	x	
Mathematics (Further)	x	x		Portuguese	x	x	
Mathematics (Additional)	x	x		Spanish	x	x	
English				Arabic	x	x	
English	x	x		Bengali	x	x	
English literature	x	x		Chinese	x	x	
English language	x	x		Gujarati	x	x	
Sciences				Japanese	x	x	
Biology	x	x		Modern Hebrew	x	x	
Human Biology	x	x		Panjabi	x	x	
Chemistry	x	x		Polish	x	x	
Physiscs	x	x		Russina	x	x	
Science	x	x	x	Turkish	x	x	
Electronics	x	x		Urdu	x	x	
Enviromental Science	x	x		Persian	x	x	
Geology	x	x		**Arts**	x		
Engeneering				Drama	x	x	
Construction				Communication	x	x	
Health				Performing	x	x	
Health and Social Care			x	Media, Film, tv	x	x	
Economics				Film	x	x	
Economics	x	x		Drama	x		
Business Economics	x	x		Music	x	x	
Business studies	x	x	x	Music Technology	x	x	
Home Economics	x	x		Dance	x	x	
Accounting	x	x		Art and Design	x	x	x
Humanities				Art and Design (Graphics)	x	x	
Geography	x	x		Art and Design (Photography)	x	x	
World development	x	x		A Level Art and Design (Textiles)	x	x	
History	x	x		Art and Design (3-D Studies)	x	x	
Ancient History	x	x		Art and Design (Critical Studies)	x	x	
Classical Civilisation	x	x		Fine Art	x	x	
European Studies	x			History of Art	x	x	
Archaeology	x	x		**Design and Technology**			
Law	x	x		Design/Tech & Food Technology	x	x	
Logic/Philosophy.	x	x		Design/Tech & Systems	x	x	
Government & Politics.	x	x		Design/Tech & Production Design.	x	x	
Psychology	x	x		**Information and communications technology**			
Sociology	x	x		Computer Studies/Computing	x	x	
Social Policy.	x	x		Information Technology	x	x	
Social Science Citizenship.	x	x		Information and communications technology			x
Psychology JMB/NEA.	x	x					
Public Understanding.	x	x					
General Studies	x	x					
Critical Thinking	x	x					
Greek	x	x					
Latin	x	x					
Others Classical Studies	x	x					

Note: GCE A Level (GA), GCE AS Level (GAS), GCE AS Double Award Level (GAD)

A3. Descriptive statistics: sample and control variables

In each of the following tables the mean and the standard deviation, the average difference between the alternative groups considered and a two sample t-tests for a *difference* in mean are reported for boys and girls (Table A3a) and for single-sex and mixed schools (Table A3b) are reported. The minimum and max values are also included but just for school's characteristics.

Table A3a. School's characteristics: comparing female and male students

	Girls N(216,883)		**Boys N(195,021)**		**Diff. = (Girls-Boys)**		**t test**
	Mean	*Std.Dev*	*Mean*	*Std.Dev*	*Mean*	*Std.Dev*	*p-value*
School's caractheristics (ks5)							
% of pupils taking FSM	5.33	(0.019)	4.91	(0.019)	0.420	(0.027)	***
% of pupils with statement for SEN	1.52	(0.007)	1.61	(0.009)	-0.091	(0.011)	***
% of pupils English not first language	9.07	(0.044)	8.01	(0.042)	1.063	(0.061)	***
% of Whites	66.74	(0.102)	65.18	(0.111)	1.564	(0.151)	***
% of Bangladeshi/Pakistani	2.78	(0.024)	2.18	(0.019)	0.603	(0.031)	***
% of Chinese	2.71	(0.019)	2.63	(0.020)	0.073	(0.028)	***
% of Indian	0.49	(0.002)	0.48	(0.003)	0.013	(0.004)	***
% of Caribbean Black	1.14	(0.009)	0.96	(0.008)	0.176	(0.012)	***
% of African Black	2.04	(0.014)	1.71	(0.013)	0.334	(0.019)	***

*Note: SEN= Special Educational Needs; FSM=Free School Meals Eligibility; ks5= Key Stage. Asterisks indicate significance at * 0.1 ** 0.05 *** 0.01 levels, respectively.*

Table A3b. Comparing Mixed and Single-sex schools

Panel A. Sample description

	Full Sample N(411,904)		**Girls N(216,883)**		**Diff. = (Girls-Boys)**		**t test**
	Mean	Std.Dev	Mean	Std.Dev	Mean	Std.Dev	p-value
	(1)		(2)		(3)		
Child's caractheristics (ks5)							
Age	16.72	(0.001)	16.70	(0.001)	-0.05	(0.002)	***
White	0.82	(0.001)	0.82	(0.001)	-0.01	(0.001)	***
Bangladeshi/Pakistani	0.04	(0.000)	0.04	(0.000)	0.00	(0.001)	*
Chinese	0.01	(0.000)	0.01	(0.000)	0.00	(0.000)	**
Indian	0.04	(0.000)	0.04	(0.000)	0.00	(0.001)	***
Black Caribbean	0.01	(0.000)	0.02	(0.000)	0.01	(0.000)	***
Black African	0.03	(0.000)	0.03	(0.000)	0.00	(0.001)	***
Others	0.06	(0.000)	0.06	(0.001)	0.00	(0.001)	***
First language: English	0.88	(0.001)	0.88	(0.001)	0.00	(0.001)	***
Gifted & Talented student	0.21	(0.001)	0.22	(0.001)	0.01	(0.001)	***
SEN (at leats one year ks5)	0.06	(0.000)	0.05	(0.001)	-0.03	(0.001)	***
Socioeconomic Status (ks5)							
IDACI	0.17	(0.000)	0.17	(0.000)	0.01	(0.001)	***
FSM	0.07	(0.000)	0.08	(0.001)	0.01	(0.001)	***
Single-sex school							
Enrolled in ks3	0.14	(0.001)	0.15	(0.001)	0.04	(0.001)	***
Enrolled in ks4	0.18	(0.001)	0.20	(0.001)	0.05	(0.001)	***
Enrolled in ks5	0.14	(0.001)	0.15	(0.001)	0.03	(0.001)	***

*Note: SEN= Special Educational Needs; FSM=Free School Meals Eligibility; IDACI= Income Deprivation Affecting Children Index; ks5= Key Stage. Asterisks indicate significance at * 0.1 ** 0.05 *** 0.01 levels, respectively.*

Panel B. School's characteristics

	Full Sample N(411,904)		**Girls N(216,883)**		**Diff. = (Girls-Boys)**		**t test**
	Mean	Std.Dev	Mean	Std.Dev	Mean	Std.Dev	p-value
	(1)		(2)		(3)		
School's caractheristics (ks5)							
% of pupils taking FSM	5.13	(0.013)	5.33	(0.019)	0.42	(0.027)	***
% of pupils with statement for SEN	1.57	(0.006)	1.52	(0.007)	-0.09	(0.011)	***
% of pupils English not first language	8.56	(0.031)	9.07	(0.044)	1.06	(0.061)	***
% of Whites	65.99	(0.075)	66.74	(0.102)	1.56	(0.151)	***
% of Bangladeshi/Pakistani	2.49	(0.016)	2.78	(0.024)	0.60	(0.031)	***
% of Chinese	2.67	(0.014)	2.71	(0.019)	0.07	(0.028)	***
% of Indian	0.49	(0.002)	0.49	(0.002)	0.01	(0.004)	***
% of Caribbean Black	1.05	(0.006)	1.14	(0.009)	0.18	(0.012)	***
% of African Black	1.88	(0.009)	2.04	(0.014)	0.33	(0.019)	***

*Note: SEN= Special Educational Needs; FSM=Free School Meals Eligibility; ks5= Key Stage. Asterisks indicate significance at * 0.1 ** 0.05 *** 0.01 levels, respectively.*

A4. The early specialized subgroups

At k-stage 4 most students choose at least one typically male and one typically female s_n and thus for them both the grades in male and female subjects are available. However, respectively 7% and 11% of the students have the grade in male subjects or the grade in female subjects in blank. This might be due to random distributed missing data or might be explain by previous educational choices whether at k-stage 4 they choose respectively only female subjects or male subjects. Let call them respectively *"just-male-grades subgroup"* and *"just-female-grades subgroup"*.

In the Table A4a I report the mean and the standard deviation of the k-stage 4 *masculinity z-score* for the subgroups of students with both grades and the other two subgroups. It appears that the just-male-grade subgroup are significantly more specialized in male grade that an average students and that the just-female-grade subgroup is more specialized on female grade.

Table A4a. Masculinity z-score and average score in k-stage4 and k-stage 5

	Girls		**Boys**		
Key Stage 4	*Mean*	*Std.Dev*	*Mean*	*Std.Dev*	*Obs*
Both grades subgroup					
Average score	0.460	(0.000)	0.470	(0.000)	465,610
Z-score	-0.280	(0.002)	0.300	(0.002)	465,610
Just-male-grades subgroup					
Average score	0.500	(0.000)	0.510	(0.000)	40,591
Z-score	0.880	(0.006)	1.180	(0.004)	40,591
Just-female-grades subgroup					
Average score	0.430	(0.000)	0.440	(0.000)	69,496
Z-score	-0.760	(0.004)	-0.230	(0.005)	69,496

The two subgroups represent 18% of the students enrolled in mixed schools and 20% of the students enrolled in single-sex schools at k-stage 5 (see Table A4b).

Table A4b. The early specialized subgroups: compare students in single-sex and mixed schools

Mixed Schools (Key Stage 5)			
	Girls	*Boys*	*Total*
Early special	38,288	32,383	70,671
	(17.70)	(17.45)	(17.57)
Others	178,099	153,272	331,371
	(82.30)	(82.57)	(82.42)
	216,387	185,655	402,042
	(100)	(100)	(100)

Single-sex Schools (Key Stage 5)			
	Girls	*Boys*	*Total*
Early special	7,609	6,083	13,692
	(18.70)	(22.48)	(20.23)
Others	33,059	20,993	54,052
	(81.30)	(77.54)	(79.79)
	40,668	27,076	67,744
	(100)	(100)	(100)

Note: Percentages are reported in parentheses.

In general, the *just-female-grades subgroup* students, independently by their gender and school, are the worst at school at all k-stages while those *just-male-grades subgroup* are the best students (Table A4c). This is in line with the attainments of the other students, i.e. those students having both grades. Generally, students with higher *masculinity score* are generally better than students with lower *masculinity score*, i.e. more specialized in stereotyped female subjects.

Table A4c. Average grades in k-stage3, k-stage4 and k-stage 5

	Girls		Boys		
Key Stage 4	*Mean*	*Std.Dev*	*Mean*	*Std.Dev*	*Obs*
Both grades subgroup					
Female subjects	3.90	(0.002)	3.63	(0.002)	465,611
Male subjects	3.84	(0.002)	3.65	(0.002)	465,611
Just-male-grades subgroup					
Female subjects	.	.	.	.	.
Male subjects	3.87	(0.010)	3.83	(0.007)	40,924
Just-female-grades subgroup					
Female subjects	3.52	(0.005)	3.24	(0.006)	69,538
Male subjects	.	.	.	.	.

Note: Standard errors reported in parenthesis.

For these two subgroups I imputed the missing grades through a least-squares estimation imputation procedure I fit an OLS regression model and I draw values from the corresponding predictive distribution, under the standard hypothesis of random distribution of missing data (Rubin, 1976). I include in the model the same variables listed in the Table A5 for students' characteristics, socio-economic background, school's characteristics, and previous enrolment in single-sex schools. All these variables are measured at k-stage 4. I also include the grades obtained in Mathematics, Science and English at k-stage 3.

I estimate the coefficient of the linear regression model pooling together those students with both grades and the *just-male-grades subgroup* by OLS. I use the estimated parameters to impute the grades in male subjects for the *just-female-grades subgroup (Table A4d, first column).* I repeat the same exercise to impute the grades in female subject for the *just-male-grades subgroup (Table A4d, second column).* Note that both regressions have a R-squared around 0.35 which indicates the goodness of fit of the model. Furthermore note that the correlation between the imputed grade in male subjects and the real one for those students having both grades is around 0.60. I obtained the same for the imputed grade in female subjects. This is another proof of the goodness of the imputed values.

The results presented in the sections below do not change dropping *just-male-grades subgroup* and *just-female-grades subgroup* from the dataset or repeated the analysis separately for the three samples.

Table A4d. Estimated parameters for just-male-grades subgroup and just-female-grades subgroup

kstage-4	Male grade		Female grade	
	Coef.	*Std.Dev.*	*Coef.*	*Std.Dev.*
Mean grades math (ks3)	0.022***	(0.000)	0.019***	(0.000)
Mean grades English (ks3)	0.044***	(0.000)	0.043***	(0.000)
Mean grades Science (ks3)	0.013***	(0.000)	0.011***	(0.000)
Single sex school (ks3)	-0.063**	(0.030)	-0.036	(0.025)
Single sex school: (ks4)	0.072**	(0.030)	0.016	(0.025)
Child's characteristics (k4)				
Age	-0.224***	(0.002)	-0.239***	(0.002)
Bangladeshi/Pakistani	-0.046***	(0.013)	-0.099***	(0.011)
Chinese	0.290***	(0.022)	0.298***	(0.019)
Indian	0.105***	(0.012)	0.007	(0.010)
Black Caribbean	-0.291***	(0.018)	-0.282***	(0.014)
Black African	-0.148***	(0.015)	-0.153***	(0.012)
First language: English	0.001	(0.009)	-0.095***	(0.007)
Gifted & Talented Cohort				
SEN (at leats one year ks4)	-0.538***	(0.006)	-0.497***	(0.005)
SES				
Free school meals (ks5)	-0.215***	(0.006)	-0.186***	(0.005)
Neighbourhood characteristics				
IDACI (ks5)	-0.554***	(0.013)	-0.465***	(0.011)
School's characteristics (ks5)				
% of pupils taking FSM	0.007***	(0.000)	0.008***	(0.000)
% of pupils with statement for SEN	0.002**	(0.001)	0.003***	(0.001)
Pupils/teacher ratio	0.001	(0.001)	-0.005***	(0.001)
School'squality: mean grade achieved at ks5	0.689***	(0.005)	0.647***	(0.005)
% of pupils English not first language	0.001**	(0.000)	0.002***	(0.000)
% of male student	0.150***	(0.010)	0.203***	(0.008)
% of Whites	0.001***	(0.000)	-0.001***	(0.000)
% of Bangladeshi/Pakistani	0.002***	(0.000)	-0.002***	(0.000)
% of Indian	-0.001***	(0.000)	-0.004***	(0.000)
% of Chinese	-0.022***	(0.003)	0.000	(0.002)
% of Black Caribbean	0.010***	(0.001)	0.002***	(0.001)
% of Black African	0.003***	(0.001)	0.002***	(0.001)
% of Other/Mixed ethnic group	-0.001	(0.001)	-0.003***	(0.000)
Constant	2.614***	-(0.061)	3.667***	-(0.052)
Observations	388465		423962	
R-squared	0.31		0.34	

*Note: Asterisks indicate significance at * 0.1 ** 0.05 *** 0.01levels, respectively.*

A5. Control variables

Grades	Key Stage 2 and Key Stage 3 average grades in National Curriculum assessments in English, Math and Science.
Single-sex schools	Have studied in a single-sex school at Key Stage 3 and 4 and being enrolled in a single-sex school during Key Stage 5.
Child's characteristics	
Age	In years
Ethnicity	White, Bangladeshi/Pakistani, Indian, Chinese, Black African and Black Caribbean
Special Educational Needs (SEN)	Dummy equal to 1 if he/she is received (at least once during k-stage 5) a statement for *SEN*. The Education Act 1996 says that "*a child has special educational needs if he or she has a learning difficulty which calls for special educational provision to be made for him or her*"
Gifted and Talent cohort	Dummy equal to 1 if he/she is included in the Gifted and Talent cohort. It includes those students who have one or more abilities developed to a level significantly ahead of their year group.
Migration background	Dummy equal to 1 if English is the first language
Socio-economic status	
Free School Meals (FSM)	Dummy equal to 1 if the child has received a statements for *FSM* during the same k-stage
Neighbourhood's characteristics	
IDACI score	The *IDACI* shows the percentage of children in each of the Super Output Area (SOA) that live in families that are income deprived (i.e., in receipt of Income Support, Income based Jobseeker's Allowance, Working Families' Tax Credit or Disabled Person's Tax Credit

	below a given threshold). An *IDACI* score of 0.24 means that 24% of children aged less than 16 in that SOA are living in families that are income deprived. The postcodes of pupils are used to gain the *IDACI* scores for each pupil within each school using the SOAs. The average score for each school (total of all pupils *IDACI* Score based on postcode divided by the total number of pupils) is then compared to the national 32,482 SOAs percentile rank. This then gives the school a national ranking based on the pupils within their school." (http://www.education.gov.uk/cgi-bin/inyourarea/idaci.pl).
School's characteristics	
School's quality	Pupils/teacher ratio at school's level, during k-stage 5
	Average grade achieved at k-stage 5, at school's level
Ethnic composition	Percentage of White, Bangladeshi/Pakistani, Indian, Chinese, Black African and Black Caribbean at school's level
	Percentage of students for which English is not the first language
Gender composition	Percentage of male students at school's level
Others variables at school's level	Percentage of students with *FSM*
	Percentage of students with *SEN*

A6. Does Gender Identity Matter? Comparing Female and Male Students' Choices at K-stage 5

Table A6a. Likelihood to choose Math and Statistics courses at k-stage5: OLS with school's fixed effects

	Choice of Math (k-stage 5): OLS with fixed effect at school's level							
	Grade in Art > Grade in Math				Grade in Math>Grade in Art			
	Girls		Boys		Girls		Boys	
	Coef.	*Std.Dev.*	*Coef.*	*Std.Dev.*	*Coef.*	*Std.Dev.*	*Coef.*	*Std.Dev.*
Grades (k-stage 4)								
Math	0.097***	(0.003)	0.138***	(0.004)	0.205***	(0.004)	0.268***	(0.004)
Art	-0.001	(0.002)	-0.005	(0.004)	-0.026***	(0.004)	-0.050***	(0.003)
Constant	-0.072	(0.057)	-0.287***	(0.081)	-0.458***	(0.055)	-0.673***	(0.079)
R-squared	0.27		0.32		0.27		0.32	
Observations	66384		58830		66384		58830	

*Note: All control variables included. Robust standard error accounts school-level clustering (reported in parenthesis). Asterisks indicate significance at * 0.1 ** 0.05 *** 0.01 levels, respectively.*