The cost to act "girly": gender stereotypes and educational choices

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Abstract

This paper suggests that at the origin of gender segregation in the labour market there is a problem of educational choice. Women are under-represented in many technical degrees, which lead to higher-paid occupations. Economic models assuming that students maximize their own utility function on the basis of expected pecuniary pay-off are not able to explain why there are such gender differences. A possible explanation could be that students are likely to follow gender stereotypes i.e. to make choices which are considered appropriate by the society for a person of their gender. The sociological concept of gender identity is integrated into an economic model of educational choices. I investigate whether boys and girls follow gender-stereotyped trajectories in education and whether the salience of gender identity varies across ethnic groups. Furthermore, the hypothesis that single-sex school attenuate the gender-stereotypes burden is tested. For the empirical application, I use the *National Pupils Datasets* which includes all pupils in state maintained schools in England, and I focus on lower and upper secondary education. The longitudinal setting allows me to identify when gender stereotypes start affecting educational choices. The main results suggest that stereotypes affect educational choices since the age of 14 and girls are more likely than boys to follow a stereotyped path. Furthermore, the intensity of gender stereotypes differs across ethnic groups due to cultural differences and different gender roles. Finally, I find that attending a single-sex school leads to less stereotyped choices, especially for girls and during sixth form.

Keywords: gender segregation, educational choices, identity, single-sex schools

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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 an explanation for the prevalence of men in more prestigious positions and well-paid occupations, as men and women have similar years of schooling and comparable educational attainments.

This paper looks at gender 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, which lead to higher-paid occupations, whereas they are over-represented in Humanities, Language, Education and Arts.

Following Akerlof and Kranton (2002), I integrate the sociological concept of gender identity into an economic model of educational choices. The idea is that students choose which subject to study based on both expected future income and on the return in terms of identity, due to a more rewarding self-image. If the student acts according to the prescribed behaviours and social norms corresponding to the own gender category, she receives an indirect utility, denominated "non-pecuniary pay-off". Conversely, violating the gender identity's prescriptions generates a loss of utility.

The presence of a non-pecuniary pay-off, linked to gender identification, might justify choices which otherwise would be considered detrimental. It might explain why talented girls choose educational careers leading to low-paid job. The reason is that the highest pecuniary pay-off is often associated to traditionally male careers, and girls enrolled in male careers might suffer a higher cost in terms of gender identity.

This analysis suggests that there is a gendered pattern in subject choice preferences which cannot be explained by gender-specific abilities. I develop a novel empirical strategy based on the intuition that two "identical" students, with identical school attainments, are expected to choose the same subjects which maximize their pecuniary pay-off. Any deviation from the "optimal" choice reflects a difference in preferences. This difference may be purely individual or may reveal gender-related preferences.

I define an indicator which describes the student's curriculum composition and measures its degree of conformity to gender-stereotyped choices. A choice is defined as "gender conformist" if is more likely to be made by same-gender students. Using the *National Pupils Datasets* (NPD), a register of all pupils in state maintained schools in England, I look at the relationship between grades obtained and curriculum (subject) choice during compulsory and post-compulsory secondary education, i.e. at 14-16 and 16-18 years old. More specifically, I verify (i) whether girls and boys follow gender-stereotyped trajectories in education and whether it happens equally within different ethnic groups; (ii) when gender identity activates along the educational path and (iii) whether single-sex schools attenuate gender-stereotypes.

According with the present analysis, gender stereotypes affect both girls and boys' educational choices and differ across ethnic groups presumably due to cultural differences and different gender roles characterization. The influence of gender roles is prominent especially for girls and it affects their educational choices already at the beginning of secondary education when they are 14 years old. Finally, the single-sex school environment alleviates gender stereotypes burden, especially for girls.

In order to attenuate gender educational segregation, these findings suggest that effective policies should be design to eliminate what constrained students' choice instead of worrying about schooling or attainments which indeed are similar across gender.

This paper extends previous literature in various ways. To the best of my knowledge this is the first empirical study incorporating both the pecuniary and non-pecuniary factors in modelling the curriculum choice process. Prior research emphasizes the underrepresentation of female students in certain high school subjects or in specific college majors. Part of this literature recognizes gender-stereotyped role as a potential cause of gender differences in subject choice but does not test it. The empirical strategy used in the present analysis permits to measure the salience of gender identity on student's choice even though gender identity is unobservable.

Additionally, the longitudinal setting allows to identify when gender stereotypes activate and start affecting educational choices comparing the curriculum choice at 16-18 years old with the choice at 14-16 years old.

Finally, in this paper I move beyond to draw causal inferences about the effectiveness of single-sex environment in alleviate the gender stereotypes burden. Most of previous studies on the effect of attending a single-sex school suffer from biases due to students' selection to mixed and single-sex schools. I correct for the no-randomness assignment to either a single-sex or a mixed school 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 indeed has predominately examined student's attainments.

2. Gender segregation in educational choices: nature or nurture?

The debate on whether the gender gap in educational choice is attributable to nature or nurture, or a combination of the two is still ongoing. Previous literature on gender based educational segregation suggests three main perspectives to look at the problem: the "biological approach" focuses on biological and neurological differences between boys and girls; the "behavioural/psychological approach" stresses on the role of psychological traits and finally, the "environmental approach" considers gender stereotypes and school's environment. This paper relates to the last approach.

According with the "biological approach", boys use more cortical areas dedicated to spatial and mechanical functioning. Conversely, girls develop more the part of the brain serving in emotional functioning and verbal learning, in particular, language and arts. For this reason, girls underperform in technical and quantitative subjects since childhood and this makes them gradually disengage from these subjects (Killgore and Yurgelun-Todd 2004; Lenroot, et al. 2007).

The "behavioural/psychological approach" argues that female educational segregation arises from a process of self-efficacy adjustment. According with Kurtz-Costes et al. (2008), girls' self-perception of 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 gaining high marks is relatively more difficult (Van de Werfhorst et al., 2003; Wilder and Powell, 1989).

The "environmental approach" is centred on the role of gender identity and it is based on Akerlof and Kranton's works (Akerlof and Kranton 2000, 2002, 2005). They argue that individuals assimilate behaviours and characteristics of the social category they belong to. The prescriptions or ideal behaviours attached to each social category are socially determined. Each person has full control on her own actions, but cannot change the social category's prescriptions by her own. Akerlow and Kraton (2000) suggests 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 to social norms (Levine, 1989; Turner, 1991).

The major division in social categories is the division by gender. Gender identity shapes children behaviour already in nursery and primary school (Browne and Ross, 1991). Akerlow and Kraton model students' choices as the result of simultaneous evaluations of both the pay-off of her actions (pecuniary pay-off) and of 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[2]. If society prescribes that ability in mathematics is incompatible with a feminine identity, than girls may decide to act conventionally and invest little on mathematics (Shamai, 1994).

The existence of a non pecuniary pay-off, associated with the individual identification with a social category, has been hypothized empirically by a number of previous works Noe' (2010) uses a survey on secondary school leavers in Italy and finds that economic incentives are not sufficient to explain the choice of girls to enrol in male-traditional field of study. Humlum et al. (2007), using Danish data from the Programme for International Student Assessment (PISA) 2000, derive two factors ("career orientation" and "social orientation") to capture individual's identity. They find that talented students do not necessarily choose career with high pecuniary pay-off. They conclude that there is a non-pecuniary identity pay-off operating in the choice process. Staw (1976) insists on the importance of beliefs and gender stereotypes assimilated during childhood which may affects further investment in gender identity during adulthood. He argues that individuals keep investing to explain to themselves the initial investment and it may results in the persistence in unproductive tasks.

The timing of gender stereotypes' activation is a policy relevant question, especially if the policy maker is inclined to believe to the Staw's argument. The "environmental approach" insists on the gradual nature of the process from childhood through adolescence. Individuals have an initial endowment of self-identity and prior beliefs and information determined by the social environment. The sense of self is then shaped through a complex mechanism of social interactions, self-signalling and imperfect recalling of past feelings and true motivations (Bénabou and Tirole, 2007). People anchor on their actual beliefs and highly invest on identity especially when they feel uncertain on their long-run values or in situations of incomplete information. This is more likely in particular phases of life (e.g. during adolescence), in contingent circumstances (e.g. during economic transition period) or for specific population groups (e.g. migrants).

[2] The non-pecuniary pay-off derives by student's membership to one group net of the cost faced to fitting in the social category respecting its prescribed characteristics/behaviours. It is worthwhile to note that, if the reason for gender differences in subjects' choice is exclusively biological or psychological, the utility function includes just a pecuniary pay-off and the optimal choice maximizes the monetary return to schooling.

Another policy-relevant question is related to the importance of school's environment in shaping of gender identity. Studying in a single-sex school may give girls more freedom in exploring interests and abilities, while coeducational settings reinforce gender-stereotypes. In Jackson's words "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" (Jackson, 2009). 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.

Several empirical studies show that girls are more likely to choose and have higher attainments in male-dominated subjects 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; Solnick, 1995). Tidball (1985, 1986) argues that women successful in higher education male-dominated fields 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's type if in previous grades they attended a school with a higher percentage of female students. On the contrary, in a recent paper by Jackson (2011) using data from Trinidad and Tobago, there is little evidence that single-sex schools lead to a more efficient allocation of talent and that it increases female representation in field commonly dominated by male students. Finally, most of the studies do not find differences either in attainments or educational trajectories for male students in single-sex or mixed schools[3].

3. Modelling educational choices: pecuniary and non-pecuniary pay-offs

The theoretical approach used in this paper is based on Akerlow and Kranton's model. Akerlof and Kranton (2000, 2002) add a non-pecuniary component to the determinants of individual economic behaviour. Individual utility depends by the pay-off of own actions and by the indirect utility deriving from self-identification.

Following their approach I model the role of gender identity for boys' and girls' curriculum choice. It is worthwhile to point out the distinction between "gender" and "gender identity". In fact, being a girl does not necessarily mean to behaviour "girly". Gender is an exogenously assigned characteristic; conversely, gender identity is sketched by a set of attributes defined by social prescriptions. 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 fits with the "girly" stereotype. The more the matching is close the higher is her non-pecuniary pay-off.

Empirically, the main challenge is that gender identity cannot be observed. Nevertheless, gender identity is indirectly reflected in students' educational choices. In this paper I develop a novel empirical strategy that permits to individuate if and how gender identity influences

[3] Nevertheless, in some cases boys are found to do better in languages, reading and writing test in single-sex schools than in mixed schools (see for example Haag, 1998; Stables, 1990).

students' choices. The basic idea is that, two (observably) identical students, a boy and a girl, achieving the same grades at school should choose the same subjects. Suppose that they both agree on which educational choice leads to better job opportunities and higher earnings. If just 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.

Empirical evidences suggest that there is a gendered pattern in subjects'choice preferences: girls more frequently enrol in non-quantitative subjects while boys prefer technical and quantitative subjects. This pattern cannot be explained by differences in attainments or gender-specific abilities but it reflects the presence of gender stereotyped preferences. It makes possible to explain why high-ability female students ultimately choose educational curriculum leading to low-paying career. If the pecuniary pay-off is the only component of student's utility function, this kind of choice would otherwise be judged as detrimental.

For example, consider a girl and assume that she is a rational agent willing to maximize her utility. Suppose that non-quantitative subjects are considered typically "girly" subjects, while quantitative subjects are more likely to be chosen by boys. Consider two possible scenarios. In the first scenario, she is better in non-quantitative subjects. In this case there is no conflict between what the gender identity prescribes and what a choice based on individual abilities suggests. Indeed, both lead her to enrol into a non-quantitative curriculum. In the second scenario she is better in quantitative subjects than in non-quantitative subjects. If she decides to choose accordingly with her abilities she might be obliged to bear the cost deriving from the mismatch of her choice with the gender prescribed behaviour. Nevertheless, following a quantitative educational path may be the premise to find a well-paid job in the future. Thus, the decision is uncertain and depends by the present cost of a "non-conventional" choice and the expected utility of a better job. She may decide to choose a quantitative curriculum whether she evaluates the expected utility coming from better job opportunities higher than cost of an anti-conformist choice[4].

In order to compare students' choice of subjects, I define a continuous variable which varies between 0 and 1, with 1 corresponding to a male stereotyped choice and 0 to a female stereotyped choice. A detailed description of the choice variable (henceforth called "*masculinity score*") is reported in the paragraph 6.

I consider the last stage of a three-period educational choice model for secondary education students aged 16-18 years old. In the first period students are aged 11–14 years. At this stage, they cannot choose their curriculum and they all study Math, English and Sciences. At the end of the period they receive one grade for each subject studied. In the second period students are aged 14–16 years. They choose within a broad set of subjects taking in account of their revealed abilities in the three main subjects and their preferences. At the end of this stage they get a grade for each subject chosen. I use it 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 those subjects who are more likely to be chosen by male students; the second one is computed including the grades obtained in "typically" female subject. At the end of this period they get

[4]The return deriving from identifying with a specific group is something subject to change. The uncertainty is due by the usual assumption that individuals gain better knowledge of their preferences through experience and by social context or interactions (Grotevant, 1987). The belief about "what kind of a person" is even more dynamic during adolescence when the idea of "self" is still in development.

precise information about their abilities and a clearer idea of which subjects they prefer. Both information guide the student in the selection of the subjects to study in the last two year of secondary education which is the choice modelled in the present analysis.

I expect to find that differences in gender stereotypes induce male and female students to make different choices. Furthermore, the salience and the characterization of gender stereotypes can vary across ethnicity and between single-sex and mixed schools. Thus, the educational choice of a male and a female identical students from different ethnic groups or enrolled in different school's types may differ.

I proceed by estimating the subjects' choice model with *Ordinary Least Squares* (OLS) method separately for boys and girls and for White, African Black, Caribbean Black, Bangladeshi/Pakistani, Indian and Chinese students. Finally, I estimate the educational choice for boys and girls in single-sex and mixed schools using an endogenous switching model which allows taking in account of self-selection bias in single-sex schools' enrolment. This is discussed in details in the next paragraph.

In order to illustrate how the empirical strategy works in practice, let compare just female and male students. I estimate the two following linear equation separately for boys, equation (1), and for girls, equation (2):

$$y_i^B = \alpha_{0_i}^B + \alpha_1^B mgrade_{i_1} + \alpha_2^B fgrade_i + \alpha_3^B X_i + \beta_1^B F_{si} + \varepsilon_i^B \qquad (1)$$

$$y_i^G = \alpha_0^G + \alpha_1^G mgrade_{i_1} + \alpha_2^G fgrade_i + \alpha_3^G X_i + \beta_1^G F_{s_i} + \varepsilon_i^G \qquad (2)$$

$$with \quad i = 1,...,N$$

The two variables *mgrade* and *fgrade* are respectively the average *grade in male subjects* and the average *grade in female subjects* obtained at the end of the previous period when they are 16 years old. The vector X_{i_2} contains a number of control variables[5] 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 first period as a proxy of general cognitive skills. A set of dummies 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.

The coefficients α_1^B, α_1^G and α_2^B, α_2^G represent the marginal change of the *masculinity score* for a male and a female student given a unit change in the *grade in male* and *female subjects*, respectively. They indicate how much grades account in determining the curriculum's choice. Suppose that female and male students choose the curriculum on the basis of their attainments. In this scenario $\alpha_1^B = \alpha_1^G > 0$ and $\alpha_2^B = \alpha_2^G < 0$. Now, suppose that $\alpha_1^G < 0$ (or $\alpha_1^B > \alpha_1^G > 0$) and $\alpha_2^B > 0$ (or $|\alpha_2^B| < |\alpha_2^G| < 0$). In this second scenario, attainments cannot explain students' choice by themselves, and the non-pecuniary component might play a role. When the student "invests" in gender identity capital she chooses a set of subjects in line with

[5] The complete list of control variables is reported in the Table A6 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 when they were aged 11-14.

gender-specific prescriptions and previous attainments matter only marginally or do not matter at all. In the extreme case of a "girly" female student her demand of typically male subjects is completely unresponsive to any increases of *mgrade* $(-\infty \leq \alpha_1^G \leq 0)$.

The same considerations are valid comparing female and male students from different ethnic groups and enrolled in single-sex or mixed schools. Ethnicity such as gender is exogenously determined and the model can be estimated by OLS method. However, the decision to enrol in a single-sex or mixed school may be not random and checking for potential selection bias is required.

4. Self-selection in single-sex schools

Students enrolled in single-sex schools might differ from students in coeducation. Single-sex schools might draw a particular selection of 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 into 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.

An early discussion on self-selectivity was that of Roy (1951). The econometric discussion has been followed by Gronau (1974), Lewis (1974) and Heckman (1974). Since those years, self-selection issue a have been widely discussed[6]. I use the endogenous switching regression model which allows correcting for both selection biases as well as unobservable individual heterogeneity in returns (Quandt, 1972). The observed outcome derived from two truncated distribution:

$$y_i = zy_i^1 + (1-z)y_i^0 \qquad (3)$$

$$y_i^0 = \alpha_{i0} + \beta_{0v}V_0 + \varepsilon_{i0} \qquad \text{if } z_i = 0 \qquad (4)$$

$$y_i^1 = \alpha_{i1} + \beta_{1v}V_1 + \varepsilon_{i1} \qquad \text{if } z_i = 1 \qquad (5)$$

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:

[6] A complete review of the econometric methods used to solve sample selection and self-selection issue goes beyond the scope of this paper. Lee (2000) and Mokhtarian and Cao (2007) provide a recent survey of the more common methodology to address self-selection.

$$z_i^* = \gamma W_i + u_i \qquad (6)$$

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 $V_{0,1}$ and W_i and $E[\varepsilon_{i0} \mid V_0, z_{i,} W_i,] = E[\varepsilon_{i0} \mid V_0, z_i]$ and $E[\varepsilon_{i1} \mid V_1, z_{i,} W_i,] = E[\varepsilon_{i1} \mid V_1, z_i]$. 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 $\varepsilon_{0,1}$ 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:

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

where σ_u^2 is a 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 a covariance of u_i and ε_{i0}, σ_{u1} is a covariance of u_i and ε_{i1}. The sign and the 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 y_i^1 are never observed simultaneously (Maddala 1993).

I jointly estimate the main equation and the selection equation allowing for correction between error terms[7] (Lokshin and Sajaia, 2004). The selection equation is estimated trough probit regression to predict the probability to enrol in single-sex school. The main equation is then estimated through linear regression and the Inverse Mill's ratio is included as regressor. In the endogenous switching regression approach the main equation is estimated separately for single-sex and mixed schools' students. The results obtained are very similar to those obtained running a selection model *à* 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 *à* la Heckman procedure twice requires two different selection equations, one for each regime.

A key advantage of the endogenous switching regression model is that it allows for heterogeneity in covariates' effects across single-sex/mixed schools' regime. Indeed, 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, by way of an intercept shift in the masculinity score function, or it should be also assumed to have a 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

[7] 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.

defining students' choices. The absence of the opposite-pressure might cancel out the non-pecuniary component from the students' utility function and increase the return of an additional unit of effort in investment in human capital.

The endogenous switching model does not strictly require an exclusion restriction. However, practical experience suggests that it performs poorly if this is the case. A convincing identification of this model requires that at least one variable in W_i is excluded from the main equation (Woodridge, 2002). I use the density of single-sex schools in each *Local Education Authority*[8] (*LEA*) as 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. However, 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 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. Indeed, in each *LEA* around eight per cent of k-stage 5 schools are single-sex schools and that in some *LEA* this percentage rise to 25%. Additionally, it is worthwhile to note that the density of single-sex school pass the standard thumb rule for F-statistics testing the instrument against the null that it is irrelevant in the selection equation estimation[10]. Finally, the estimation results of the selection equation confirm 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 *National Pupils Datasets* (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 compulsory secondary education is divided into two key stages, k-stage 3 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, commonly denominated sixth form, provided for pupils aged 16 to 18 years. At the end of k-stage 3 students take the k-stage3 National Curriculum tests in English, Mathematics and Sciences. Instead assessment of pupils at k-stage 4 and k-stage 5 consists of a set of examinations in subjects which students can choose from a range of different subjects[11]. The longitudinal design of this survey allows matching prior attainments at k-stage 3, with later attainments at k-stage 4 and 5.

For this analysis, I restrict the sample to the cohort of k-stage 5 final candidates for the 2007/2008 academic year, which counts about 412,000 observations. My sample includes only those students continuing their education on key-stage 5 and choosing an academic track.

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

[9] According with Department of Education's statistics, during 2007/2008 academic year around 13.8% of sixth form students do not reside in the *LEA* where they attend the school, which is a percentage higher than in k-stage 3 (8.2%) and (k-stage 4) but apparently not so concerning (http://www.education.gov.uk/rsgateway/DB/SFR/s000786/index.shtml).

[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 paragraph A1 in the Appendix.

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% the whole population of children[12].

Although the NPD is primarily an administrative register, it provides a number of variables identifying the main children's characteristics and the family socio economic background. Among the others there is a variable for ethnic origin and the language spoken at home, whether or not different from English. Moreover, there is a variable indicating the student eligibility to receive Free School Meals (FSM). This is a federally assisted meal program which provides nutritionally balanced, low-cost or free lunches to children from low-income families. Finally, the *Income Deprivation Affecting Children Index* (IDACI) is an indicator of income deprivations amongst children. It captures the proportion of the child population experiencing income deprivation in an area[13]. The variable "*Gifted and talented student*" identifies those children who have been recognized by their schools to have an ability to develop (or the potential to develop it) to a level significantly ahead of their year group.

In the Table 1, I report the characteristics of girls and boys estimation sample. Girls represent around 53% of the full sample. This table intends to give a general overview of the full sample composition and its main characteristics. In the column (3) I report the average difference between girls and boys and a two sample t-tests for a difference in mean. Extremely small and non-notable differences have been found to be statistically significant. Given the large sample dimension, statistical significance says little about the real significance of a difference. The difference in mean values does not underline substantial differences across gender. Nevertheless, the empirical analysis is performed separately for girls and boys.

It is worthwhile to note that the IDACI score is about 16% which is around the median value and lower than the mean value of the IDACI score in England. Additionally, around 8% of student receives a FSM at least once during k-stage 5, which is slightly below the national average of FSM beneficiary in secondary school which is around 10%[14]. This indicates that the sample is more representative of a sub-population richer than the national average. It is not surprisingly given that it includes just those students continuing in post-compulsory education.

About 18% of the estimation sample includes students from ethnic minorities groups and more specifically around 4% of Bangladeshi/Pakistani and Indian, 1% of Chinese and Black Caribbean, 3% of Black African and 6% of students from other ethnic groups (not included in the analysis). In Table A3b and Table A3c in the Appendix I report the same statistics as in Table 1 respectively by ethnic groups and school's type. It is worthwhile to note that students from ethnic minorities, and in particular Bangladeshi/Pakistani, Black Caribbean and Black African, live in poorer areas and are more likely to received FSM. Non-White students are more likely to enrol in single-sex schools. The high incidence of students from ethnic

[12] For more 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.

[13] For more details, see Table A6 in the Appendix.

[14] For more details, see "Statistics of Education - Schools in England (2003)", http://www.dfes.gov.uk/rsgateway/DB/VOL/v000417/index.shtml

minorities in single-sex schools might be due to particular religious orientation or segregation phenomenon at school or *LEA* level.

Table 1. Sample description: Comparing girls and boys

	Girls N(216,883)		Boys N(195,021)		Diff. = (Girls-Boys)		t test
	Mean	Std.Dev	Mean	Std.Dev	Mean	Std.Dev	p-value
Child's caractheristics (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 (at leats one year ks5)	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 5

In addition to NPD data, I use data from *LEA and School Information Service* linking together existing 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 k-stage 5 school level variables used in the estimations separately by gender (Table A3a), by ethnic group (Table A3b) and by single-sex and mixed school (Table A3c). Remarkably, ethnic composition at school level shows a certain degree of segregation. In particular, Bangladeshi/Pakistani and Chinese students are more likely to study where the concentration of the same-ethnicity students is higher (Table A3b). In general single-sex schools are more multicultural than mixed schools. Indeed, Whites students represent around 70% of students in mixed schools and only 53% of students in single-sex schools (Table A3c).

6. Defining educational choices and attainments

As anticipated in previous paragraphs, I define a variable which is named *masculinity score* which describe 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 a typical female curriculum. In order to define the *masculinity score*, I aggregate all courses offered at k-stage 5 in 10 groups of subject areas (Mathematics, English, Sciences, Health, Economics, Humanities, Languages, Arts, Design and Technology, Information and communications technology)[15]. Students are able to compose their own curriculum autonomously. Let assume that the student *i* choose $N_1 = n_1$ courses of $s = 1$, corresponding to Math, $N_2 = n_2$ courses of $s = 2$, corresponding to English, $N_3 = n_3$ courses of $s = 3$, corresponding to Sciences and that $N_S = 0 \ \forall s > 3$. The student's curriculum choice can be described by a set of 3 count variables $[N_1,..., N_3]$. 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* associated with her choice as following:

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

$$=\frac{1}{3}\left(Pr(gender=1|N_1=n_1)_{LEA}+Pr(gender=1|N_2=n_2)_{LEA}+Pr(gender=1|N_3=n_3)_{LEA}\right)$$

where the first factor is the *partial masculinity score* associated with the choice $N_1 = n_1$. It is defined as the probability that a boy chooses $N_1 = n_1$ courses of Math, over the probability that a random student, studying in the same school or in a school within the same *LEA,* makes the same choice. Both probabilities are 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.

Following this example, let suppose that the percentages of male students studying in the same *LEA* and choosing $N_1 = n_1$ of Math, $N_2 = n_2$ of English and $N_3 = n_3$ of Sciences are respectively 80, 40 and 20 percent. Her masculinity score is $(0.8+0.4+0.2)/3 = 0.4\overline{6}$. Note that, given that the *masculinity score* depends not only by individual choices but also by schoolmates' choices, two students choosing the same curricula not necessarily end up having the same masculinity score if they are studying in different *LEA*.

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

$$Masc=\frac{1}{\bar{S}}\sum_{s=1}^{\bar{S}}\left(\frac{Pr(N_s=n_s, gender=1|N_s>0)_{LEA}}{Pr(N_s=n_s|N_s>0)_{LEA}}\right)=\frac{1}{\bar{S}}\sum_{s=1}^{\bar{S}}Pr(gender=1|N_s=n_s)_{LEA} \qquad (3)$$

where $n_s = 1,..., \overline{N}_s$ is the number of courses for each type of subject area $s = 1,..., \overline{S}$ the student chooses. The *masculinity score* is a value included between 0 and 1 where 1 correspond to a curriculum chosen exclusively by boys. It is computed individually for each student *i* although in this paper I usually omit the subscript *i* for the sake of simplicity of notation whenever this is clear from context. I standardize the *masculinity score* computing the z-score

15 For the complete list of subjects included in each category see Table A2a in Appendix.

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*:

$$Masc\_z_i = \frac{Masc_i - mean(Masc_{LEA})}{sd(Masc_{LEA})} \tag{4}$$

The higher the masculinity score is, the more likely is that it is 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. Grades are reported on an eight-point scale: A*, A, B, C, D, E, F, U, with U corresponds to fail. This alphabetic code is easily convertible to a numeric code from 0 to 7 corresponding respectively to U and A*. I define two variables for k-stage 4 attainments: the "*grade in male subjects*" and the "*grade in female subjects*". The first one is the average grade obtained at k-stage 4 in those pairs of courses-per-subject n_s chosen mainly by boys within the same *LEA*. Conversely, the "*grade in female subjects*" is the average grade obtained at k-stage 4 in those pairs of courses-per-subject n_s chosen mainly by girls[16]. 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,

$$mgrade = \frac{\sum_{n_s=1}^{\overline{N_s}} grade_{n_s}}{\overline{S}} \Leftrightarrow \tag{5}$$
$$Pr(gender=1 | N_s = n_s)_{LEA} \geq Pr(gender=0 | N_s = n_s)_{LEA} \; ;$$

Otherwise it is considered a female n_s and it contributes to the average *grade in female subjects*[17]:

$$fgrade = \frac{\sum_{n_s=1}^{\overline{N_s}} grade_{n_s}}{\overline{S}} \Leftrightarrow \tag{6}$$
$$Pr(gender=1 | N_s = n_s)_{LEA} < Pr(gender=0 | N_s = n_s)_{LEA}$$

In the previous example, the average grade obtained in $N_1 = n_1$ of Math would be used to compute the *grade in male subjects* given that 80% of those students making the same choice are males and just 20% are females. Conversely the average grade obtained in $N_2 = n_2$ of English

[16] At k-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 female subjects* are available. However, respectively for the 7% and 11% of the students I do not observe either the grade in male subjects or the grade in female subjects. Let call them respectively *"just-male-grades subgroup*" and *"just-female-grades subgroup*". For these two subgroups I impute the missing grades through imputation procedure. For more details see paragraph A4 in the Appendix. The following analysis includes imputed data. Excluding imputed observations does not change the results.

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

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 identify different groups for which gender stereotypes might differently affect educational choices. In Table 3, 4, 5, I compare attainments and subjects' choice for boys and girls and in Table 6 and 7 for students in single-sex and mixed schools. Educational choices across ethnic groups are reported in Table A5a in the Appendix.

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

	Girls		**Boys**		
	Mean	**Std.Dev**	**Mean**	**Std.Dev**	**Obs.**
Attainments at ks3					
Math	29.08	(0.016)	29.89	(0.016)	346,372
English	29.64	(0.016)	28.06	(0.019)	342,942
Science	50.17	(0.026)	51.06	(0.027)	344,795
Average	36.29	(0.013)	36.35	(0.014)	345,847
Attainments 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
Attainments 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: ks3, ks4, ks5= k-stage 3, 4 and 5

Table 3 reports the average grade achieved in Math, English and Science during k-stage 3, and in female and male subjects during k-stage 4 and 5, separately by gender. During k-stage 3 the only subjects where girls are better off is English. Conversely, during k-stage 4 and 5 girls are constantly better than boys both in male and female subjects.

It is worthwhile to note that during k-stage 4 girls' attainment in female subjects is slightly higher than their attainment in male subjects and vice versa 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 k-stage 5 girls should specialize in female subjects and boy in male subjects. Apparently, this is what they do. As shown in Table 4, the boys' *masculinity z-score* at k-stage 5 stages is higher than the girls' one. In other words, both girls and boys follow their abilities. Indeed, boys choose relatively more male subjects than girls, and girls choose more female subjects than boys.

An empirical strategy to identify if students are guided in their choice exclusively by previous attainments is to compare two students, a girl and a boy, who got the same grades and are equally good 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 "average" students and the "best" students. The worst students achieve the lowest grade in both male and female subjects and the best students the highest[18]. The mean masculinity score is computed for each pair (Table 5). Notably, girls and boys on equal attainments make different choices and this happens within all the "identical"-students' pairs 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 vice versa for boys.

Table 4. Masculinity score in k-stage4 and k-stage 5

	Girls		Boys		
	Mean	**Std.Dev**	**Mean**	**Std.Dev**	**Obs**
K-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
K-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

As said before, I compare students in single-sex schools and students in mixed school as a strategy to test whether gender identification affects choices. The same statistics presented in Table 3 and Table 4, are shown separately for the two school's types in Table 6. On average, students in single-sex schools are more specialized in male subjects than students in mixed schools. 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.

Table 5. 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: Worst student: bottom tertiles, Average student: medium tertiles, Best student: top tertiles of both grade in male and female subjects.

It is worthwhile to note that girls studying in a single-sex school choose a more male-oriented curriculum. Indeed, their *masculinity score z-score* is higher than in mixed schools. It might be due to selection of the best students in single-sex schools or it might confirm that studying in absence of the opposite sex alleviates the gender identity burden. Table 7 supports the last hypothesis. Although female students are more inclined to specialized in female subjects in both mixed and single-sex schools, those studying in a single-sex school make choices more similar to their male schoolmates. The difference between the *masculinity score* of

[18] 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.

boys and girls in the "average" and "best" students' group is lower in single-sex than in mixed schools.

Table 6. Attainments and masculinity score at k-stage4 and k-stage 5 comparing students in single-sex and mixed schools at k-stage 5

	Mixed schools (ks5)					Single-sex schools (ks5)				
	Girls		Boys			Girls		Boys		
	Mean	Std.Dev	Mean	Std.Dev	Obs	Mean	Std.Dev	Mean	Std.Dev	Obs
Attainments at k-stage 4										
Female subjects	5.06	(0.003)	4.81	(0.004)	171,593	5.50	(0.006)	5.33	(0.007)	51,239
Male subjects	5.03	(0.004)	4.88	(0.004)	176,319	5.52	(0.006)	5.46	(0.007)	54,899
Masculinity score k-stage 5										
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

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

Table 7. 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						
	Girls		Boys		Diff. = (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: Worst student: bottom tertiles, Average student: medium tertiles, Best student: top tertiles of both grade in male and female subjects

8. Empirical analysis results

In the following section I report the results obtained using multivariate linear and no-linear regression separately for girls and boys (paragraph 8.1) across ethnic groups (paragraph 8.2) and for students in mixed and single-sex schools (paragraph 8.3). I investigate whether (i) the gender identity, (ii) the cultural background and (iii) the school's environment matter for students' educational choices at k-stage 5. In the last part of this section, (iv) the timing of the gender stereotypes' activation is studied comparing choices at k-stage 5 with the choices at k-stage 4 (paragraph 8.4).

8.1 Does gender identity matter? Comparing female and male students' choices at k-stage 5

In the first and third column of Table 7 I report OLS estimates respectively for boys and girls[19]. The plot of the residuals against the two grades shows a nonlinear pattern. I use a likelihood ratio test to compare the likelihood of a model containing the 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[20]. In order to allow for non-linearity in the grades' profile, the two continuous variables for grades are replaced by five quintiles dummy variables. This no-linear approach is reliable given the large sample size and it allows estimating a more flexible functional form than using a polynomial function. Results are reported in the second and fourth columns respectively for girls and boys. The bottom 20 percent dummy is the omitted category.

The direction of the relation between *masculinity z-score* and grades remains the same once relaxed linearity, and that means that a linear representation is still a pretty accurate approximation of the overall relationship. However, the results from linear and the non linear model suggest that the linear model underestimates the effects of grades for the top quintile students and overestimates it for the bottom quintile students. The overall result is that according with standard utility maximization problem, a student responds to an increase in the grade choosing more subjects in the area in which he/she is performing well. However, the comparisons between the grades' coefficients for boys and girls and across grades' quintile suggests that (i) grades in male subjects matter more than grades in female subjects in determining the level of specialization; (ii) grades in male subjects matter more for boys than for girls and the opposite happens for grades in female subjects, (iii) both grades in male and female subjects matter more for the best than for the worst students; (iv) at the extremes of grades' distribution the grade's gap between girls and boys is minimum.

As a whole, these findings confirm the double nature of education as an investment and consumption good. Students consider education as an investment because they associate a higher importance to traditionally male subjects which are going to pay better in term of future earnings. Indeed, the marginal effect of one grade more in female subjects is smaller

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

[20] However, some model's estimates do not strongly show clear departure from linearity. Note that the other common regression diagnostic procedures showed no evidence of multicollinearity, heteroscedasticity, or substantial influence from outliers.

than the marginal effects of an additional unit in male subjects. This is directly related to the pecuniary components of student's utility function. Conversely, education is considered as consumption good when students' choice is affected by their gender stereotyped preferences. On average, an increase of one unit of *grade in male subjects* has an effect on *masculinity z-score* bigger for boys (0.16 standard deviation) than for girls (0.13 standard deviation), while an increase of one unit of *grade in female subjects* equally decreases the *masculinity z-score* for girls and boys (-0.05 standard deviation). Apparently, gender identity adds a positive non-pecuniary pay-off to the students' utility whether they decide specializing in the same-gender stereotyped subject.

Table 7. Subjects' choice at k-stage 5: OLS results by gender

Masculinity z-score	Girls				Boys			
	Linear		Nonlinear		Linear		Nonlinear	
	Coef.	*Std.Dev.*	*Coef.*	*Std.Dev.*	*Coef.*	*Std.Dev.*	*Coef.*	*Std.Dev.*
Attainments in female subj. (ks4)								
Continuous grade	-0.046***	(0.007)	.	.	-0.048***	(0.009)	.	.
20-40th quintiles	.	.	-0.105***	(0.011)	.	.	-0.006	(0.014)
40-60th quintiles	.	.	-0.108***	(0.012)	.	.	-0.033**	(0.016)
60-80th quintiles	.	.	-0.116***	(0.015)	.	.	-0.040**	(0.019)
80-100th quintiles	.	.	-0.139***	(0.020)	.	.	-0.161***	(0.026)
Attainments in male subj. (ks4)								
Continuous grade	0.135***	(0.006)	.	.	0.164***	(0.008)	.	.
20-40th quintiles	.	.	0.046***	(0.012)	.	.	0.127***	(0.015)
40-60th quintiles	.	.	0.106***	(0.012)	.	.	0.210***	(0.015)
60-80th quintiles	.	.	0.224***	(0.015)	.	.	0.352***	(0.019)
80-100th quintiles	.	.	0.502***	(0.022)	.	.	0.560***	(0.027)
Single sex school: (ks5)	0.082**	(0.034)	0.079**	(0.033)	0.053	(0.039)	0.050	(0.039)
Constant	-2.202***	(0.149)	-1.701***	(0.147)	-0.916***	(0.161)	-0.534***	(0.160)
Observations	71130		71130		64197		64197	
R-squared	0.04		0.05		0.05		0.06	

*Note: All control variables for children, school and neighbourhood's characteristics and SES used. Robust standard error accounts LEA-level clustering (reported in parenthesis). Asterisks indicate significance at * 0.1 ** 0.05 *** 0.01levels, respectively.*

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

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. The girls' cost of behave against social prescriptions is reduced by studying in an environment where the gender pressure is lower.

The R-squared value is quite low which constitutes a warning signal of the omission of relevant variables to the model. Previous literature on gender segregation in education, suggests that school's environment plays a crucial role in guiding students' choices. Although I control for a large set of variables for schools' characteristics I suspect that there are still some school's unobserved characteristics (e.g. teachers' characteristics) which might affects subjects' choice. I include school fixed effects using a dummy for each school. It eliminates any fixed factor that impacts the educational choices of all students within the same school.

School fixed effect's results are reported in the fourth columns of Table 8[21]. I test formally the null hypothesis that the coefficients estimated through OLS are the same as the ones estimated by the fixed effects estimator and I reject the null hypothesis at 1% significance level, which confirms that school's unobservable characteristics return into bias coefficients. However, coefficients are qualitatively equivalent and quantitatively similar. In general, the impact of attainments on choices acquires significance an increase in absolute once controlled for unobservable at school's level. The R-squared duplicates which confirms that fixed effects increase the goodness of fit of the model.

Table 8. Subjects' choice at k-stage 5: OLS and fixed effects models' results

	OLS: Fixed effect at school's level			
Masculinity z-score (k-stage 5)	**Girls**		**Boys**	
	Coef.	*Std.Dev.*	*Coef.*	*Std.Dev.*
Attainments				
Female subjects (ks4)				
20-40th quintiles	-0.105***	(0.011)	-0.022	(0.014)
40-60th quintiles	-0.104***	(0.012)	-0.047***	(0.016)
60-80th quintiles	-0.130***	(0.014)	-0.070***	(0.019)
80-100th quintiles	-0.142***	(0.020)	-0.179***	(0.026)
Male subjects (ks4)				
20-40th quintiles	0.054***	(0.012)	0.133***	(0.014)
40-60th quintiles	0.104***	(0.012)	0.219***	(0.015)
60-80th quintiles	0.231***	(0.014)	0.371***	(0.018)
80-100th quintiles	0.501***	(0.022)	0.577***	(0.027)
Constant	-1.592***	(0.143)	-0.144	(0.157)
Observations	71130		64,197	
R-squared	0.11		0.12	

*Note: All control variables for children, school and neighbourhood's characteristics and SES used. Robust standard error accounts LEA-level clustering (reported in parenthesis). Asterisks indicate significance at * 0.1 ** 0.05 *** 0.01levels, respectively*

8.2 Does cultural background matter? Comparing subjects' choices by students from different ethnic groups at k-stage 5

Psychological literature suggests that gender stereotypes about attitude and academic abilities differ across ethnic groups. I compare boys and girls within the White group and the other 5 ethnic minorities: Bangladeshi/Pakistani, Indian, Chinese, Black Caribbean and Black African.

Regardless of the ethnic group considered, the linearity assumption is rejected and I relax linearity, as before. In order to avoid extremely small cell counts, I propose smoother estimates dividing both grades variables in three quantiles. Given that I am splitting the

[21] Full results are available on request.

sample by gender and ethnicity, broking down by too many variable categories, yield very small cells or may generate empty cells.

Table 9. Subjects' choice at k-stage 5: School's fixed effect results by gender and ethnic groups

Masculinity z-score (ks5)	**Panel A: GIRLS**					
Attainments (ks4)	*Whites*	*Bangladeshi/ Pakistani*	*Indian*	*Chinese*	*Black Caribbean*	*Black African*
Female subj.						
Medium tertiles	-0.094***	0.006	-0.418	-0.009	-0.076	0.092
	(0.011)	(0.049)	(0.401)	(0.051)	(0.109)	(0.081)
Top tertiles	-0.090***	0.207***	-0.531	0.038	-0.115	0.084
	(0.015)	(0.068)	(0.519)	(0.069)	(0.141)	(0.098)
Male subj.						
Medium quantile	0.075***	0.070	0.879**	0.195***	0.130	0.046
	(0.010)	(0.049)	(0.415)	(0.052)	(0.113)	(0.089)
Top quantile	0.271***	0.313***	0.908**	0.440***	0.234	0.390***
	(0.015)	(0.091)	(0.429)	(0.067)	(0.175)	(0.116)
Constant	-1.820***	0.089	-5.520*	-0.952*	-2.298	-0.935
	(0.156)	(0.608)	(3.230)	(0.523)	(1.471)	(0.970)
Observations	62377	2638	502	3381	832	1400
R-squared	0.10	0.28	0.61	0.27	0.44	0.34
	Panel B: BOYS					
Attainments (ks4)	*Whites*	*Bangladeshi/ Pakistani*	*Indian*	*Chinese*	*Black Caribbean*	*Black African*
Female subj.						
Medium tertiles	-0.044***	0.186***	0.148	-0.007	-0.020	0.028
	(0.013)	(0.066)	(0.334)	(0.052)	(0.183)	(0.111)
Top tertiles	-0.110***	0.093	0.227	-0.036	-0.039	-0.082
	(0.021)	(0.092)	(0.394)	(0.064)	(0.252)	(0.180)
Male subj.						
Medium quantile	0.195***	0.115	-0.069	0.213***	0.269	0.064
	(0.013)	(0.075)	(0.244)	(0.055)	(0.193)	(0.110)
Top quantile	0.391***	0.224**	-0.065	0.395***	0.102	0.416**
	(0.019)	(0.103)	(0.337)	(0.073)	(0.268)	(0.162)
Constant	-0.595***	-1.583**	0.241	2.103**	-0.932	2.098*
	(0.164)	(0.790)	(3.056)	(0.824)	(2.077)	(1.249)
Observations	56882	1938	531	3190	550	1106
R-squared	0.11	0.36	0.59	0.25	0.54	0.42

*Note: All control variables for children, school and neighbourhood's characteristics and SES used. Robust standard error accounts LEA-level clustering (reported in parenthesis). Asterisks indicate significance at * 0.1 ** 0.05 *** 0.01levels, respectively.*

The group (1) specializes accordingly with attainments: an increase of the *grade in female subjects* decreases the *masculinity z-score* and the opposite occurs for any additional unit of the *grade in male subjects*. It is worthwhile to note that the coefficients of *grade in male subjects*' tertiles are higher for boys than for girls, which indicates girls' hesitancy to make a choice against stereotypes. For the group (2) an improvement in either male or female subjects returns into higher specialization in male subject at k-stage 5. The group (3) chooses the degree of specialization only on the basis of the *grade in male subjects* and a change of the *grade in female subjects* does not alter educational choices. In both groups, gender stereotypes do not matter for girls. Presumably, the indirect utility deriving from the expectation of higher earnings linked to male specialization compensates the cost due to the identity loss. For the group (4) attainments do not affects subjects' choice.

The marginal utility of an additional unit of grade is affected by the level of skills showed. Note that the coefficients for the highest quintile of attainments are usually significantly higher than the ones in the other quintile. The higher the current level of skills showed, the more attainments matter in guiding future choices. The cost opportunity of a gender identity loss is lower for the best students.

8. 3. Does the school's environment matter? Comparing students' choices in single-sex and mixed schools at k-stage 5

In the first two columns of Table 10, I report the results of OLS estimation with school fixed effects separately for students in mixed and single-sex schools. In the other columns I report the results of the endogenous switching regression model separately for girls (Panel A) and boys (Panel B)[22]. In the bottom part of the Table 10 I report the F statistic for the significance of the excluded instruments and the correlation coefficients *rho1* and *rho2*, which represent the correlation between the error term 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 selection issue.

The OLS estimates suggest that studying in a single-sex school pushes girls to study more typically male subjects. While in mixed schools both attainments in male and female subjects matter to subjects' choice, in single-sex schools girls decide exclusively on the basis of their grade in male subjects. However, OLS estimates might be biased due to a self-selection problem. Looking at girls' estimates, *rho2* is positive and significant. This suggests that (1) girls who choose to study in a single-sex school share unobserved characteristics which lead them to specialize in typically male curriculum and that (2) studying in a single-sex school leads them to study more male subjects and than a random female student from the sample would have chosen. However, the estimated coefficient of correlation *rho1* is not significantly different from zero, implying that a girl in a mixed school and a girl in a single-sex school would make the same choice if both enrolled in a mixed school, given their observed characteristics.

After controlling for self-selection the coefficients of attainments are still similar to the OLS estimates. It is worthwhile to note that girls enrolled in single-sex school choose just on the basis of their grade in male subjects. Conversely, their response to an increase of the grade in male subjects is higher in the mixed than in the single-sex schools with the only exception of the 40-60th quintile.

While studying in a single–sex school alleviates the gender stereotypes burden for girls, it has the opposite effect on boy's choices, even after controlling for selection. Looking at boys' estimates, *rho1* is negative and *rho2* is positive, both of them statistically significant. As for girls, boys studying in single-sex school have a higher masculinity score than a random female student would have if enrolled in a single-sex school. The estimated coefficients for grades show that boys in single-sex schools are more incline to choose on the basis of their sole skills in male subjects and the *grade in female subjects* matters only for top quantile students. Conversely, those who choose to study in a mixed-school choose free from any stereotypes constriction according with their abilities.

The general findings reported in previous paragraph are substantially confirmed. It is worthwhile to note that: (i) the coefficients for attainments in male subjects are higher for boys than for girls in both mixed and single-sex schools and it means that even studying in single-sex school does not eliminate gender stereotyped preferences; (ii) the coefficients of both female and male attainments, for both girls and boys, increase across quintiles, or in other words, grades matter more for the best students than for the worst ones.

[22] Complete results for endogenous switching models are reported in the Table A7d in the Appendix.

Table 10. Subjects' choice at k-stage 5 : OLS with school fixed effect and endogenous switching model self-selection model's results

Masculinity z-score (ks5)	Panel A: GIRLS									
	OLS, Fixed effect at school level				**Switching model**					
	Mixed schools		***Single-sex schools***		***Selection eq.***		***Mixed schools***		***Single-sex schools***	
	Coef.	*Std.Dev.*	*Coef.*	*Std.Dev.*	*Coef.*	*Std.Dev.*	*Coef.*	*Std.Dev.*	*Coef.*	*Std.Dev.*
Attainments in Female subj. (ks4)										
20-40th quintiles	-0.115***	(0.012)	-0.029	(0.030)	0.140***	(0.048)	-0.116***	(0.012)	-0.025	(0.031)
40-60th quintiles	-0.119***	(0.013)	-0.002	(0.034)	0.204***	(0.055)	-0.125***	(0.013)	0.015	(0.035)
60-80th quintiles	-0.147***	(0.015)	-0.019	(0.038)	0.283***	(0.059)	-0.134***	(0.016)	0.012	(0.040)
80-100th quintiles	-0.172***	(0.021)	0.011	(0.051)	0.403***	(0.079)	-0.172***	(0.022)	0.051	(0.051)
Male subj. (ks4)										
20-40th quintiles	0.057***	(0.012)	0.041	(0.032)	0.107**	(0.050)	0.049***	(0.013)	0.046	(0.032)
40-60th quintiles	0.100***	(0.013)	0.128***	(0.031)	0.122**	(0.050)	0.105***	(0.013)	0.121***	(0.033)
60-80th quintiles	0.238***	(0.015)	0.202***	(0.037)	0.240***	(0.061)	0.239***	(0.016)	0.172***	(0.039)
80-100th quintiles	0.517***	(0.024)	0.439***	(0.051)	0.408***	(0.077)	0.527***	(0.024)	0.415***	(0.053)
Instruments (ks5)										
Density of single-sex school					7.962***	(1.162)	.	.	.	.
Constant	-1.603***	(0.155)	-1.613***	(0.374)	-2.678***	(0.768)	-1.620***	(0.163)	-1.475***	(0.378)
Observations	59214		11916				71122			
					Selection and Instruments tests					
					rho 1					-0.026
					rho 2					0.141***
					Wald test of indep.eq: Prob>chi2					0.000
					F-stat. of joint sign. of instrum.					72.53

Masculinity z-score (ks5)	Panel B: BOYS									
	OLS, Fixed effect at school level				**Switching model**					
	Mixed schools		***Single-sex schools***		**Selection eq.**		***Mixed schools***		***Single-sex schools***	
	Coef.	*Std.Dev.*	*Coef.*	*Std.Dev.*	*Coef.*	*Std.Dev.*	*Coef.*	*Std.Dev.*	*Coef.*	*Std.Dev.*
Attainments in Female subj. (ks4)										
20-40th quintiles	-0.033**	(0.014)	0.064	(0.040)	0.102*	(0.062)	-0.017	(0.015)	0.088**	(0.042)
40-60th quintiles	-0.054***	(0.017)	-0.007	(0.048)	0.172**	(0.067)	-0.037**	(0.017)	-0.001	(0.050)
60-80th quintiles	-0.065***	(0.021)	-0.093*	(0.056)	0.356***	(0.075)	-0.029	(0.020)	-0.082	(0.054)
80-100th quintiles	-0.184***	(0.029)	-0.163**	(0.065)	0.456***	(0.101)	-0.152***	(0.028)	-0.164**	(0.068)
Male subj. (ks4)										
20-40th quintiles	0.138***	(0.015)	0.085*	(0.045)	0.097*	(0.057)	0.137***	(0.016)	0.042	(0.047)
40-60th quintiles	0.220***	(0.015)	0.194***	(0.047)	0.153**	(0.065)	0.212***	(0.016)	0.183***	(0.049)
60-80th quintiles	0.378***	(0.019)	0.312***	(0.057)	0.224***	(0.071)	0.363***	(0.020)	0.289***	(0.057)
80-100th quintiles	0.580***	(0.030)	0.540***	(0.069)	0.385***	(0.092)	0.574***	(0.030)	0.501***	(0.068)
Instruments (ks5)										
Density of single-sex school					7.690***	(1.064)	.	.	.	.
Constant	-0.437***	(0.162)	-0.495	(0.452)	-4.791***	(0.837)	-0.469***	(0.180)	-0.391	(0.490)
Observations	54786		9411				64191			
					Selection and Instruments tests					
					rho 1					-0.11*
					rho 2					0.241***
					Wald test of indep.eq: Prob>chi2					0.000
					F-stat. of joint sign. of instrum.					18.9

*Note: All control variables for children, school and neighbourhood's characteristics and SES used. Robust standard errors are reported in parenthesis. Asterisks indicate significance at * 0.1 ** 0.05 *** 0.01levels, respectively.*

8. 4. When do gender stereotypes activate? Comparing male and female students' choices at k-stage 4 and 5

I investigate when gender identity starts affecting educational choices, looking at the subjects' choice at k-stage 4. Students choose k-stage 4 subjects in the last year of k-stage 3 when they are around 14 years old. Similarly to the k-stage 5 choices model, the *masculinity z-score* at k-stage 4 is estimated as a function of the attainments at the previous k-stage-3 controlling for the same set of control variables used previously but measured one year before. Nevertheless, at k-stage 3 students have not choice about which subjects to study; they all study English, Math and Science. I use the average grade in Math and English subjects at k-stage 3 considering Math as a traditionally male subjects and English a traditionally female subject. As for the model at k-stage 5, I test formally the null hypothesis that the coefficients estimated through OLS are the same as the ones estimated by the consistent fixed effects estimator and I reject the null hypothesis at 1%. Thus, the results reported in Table 11 are for school's fixed effects[23].

In order to make the two k-stages estimates comparable, the k-stage 5 choice model is re-estimated using the average Math and English grade got at k-stage 4 as a proxy of grade in male and female subjects[24]. This new model's specification for k-stage 5 choices partially lead to same results reported in the paragraph 8.1. Indeed, it is still true that (i) Math grade matters more than English grade and that (ii) grades matter more for the best than for the worst students in determining the level of specialization. However, less clear is how gender stereotypes affect boys' and girls' choices. It is no longer true that boys values relatively more Math grade than English grade to choose their specialization and that opposite occurs for girls. Indeed, both grades in Math and English matter relatively more for boy than for girls.

Table 11. Subjects' choice at k-stage 4 and k-stage 5: School's fixed effects by gender

	Girls				Boys			
	K-stage 4		*K-stage 5*		*K-stage 4*		*K-stage 5*	
	Coef.	*Std.Dev.*	*Coef.*	*Std.Dev.*	*Coef.*	*Std.Dev.*	*Coef.*	*Std.Dev.*
Attainments in at ks3/ks4								
English								
Medium tertiles	-0.048***	(0.006)	-0.348***	(0.008)	-0.070***	(0.006)	-0.423***	(0.009)
Top tertiles	-0.071***	(0.007)	-0.693***	(0.010)	-0.107***	(0.007)	-0.855***	(0.012)
Math								
Medium tertiles	0.006	(0.006)	0.286***	(0.008)	0.015**	(0.006)	0.478***	(0.010)
Top tertiles	0.029***	(0.006)	0.933***	(0.010)	0.054***	(0.007)	1.180***	(0.012)
Constant	-4.030***		-1.207***		-3.194***		-0.539***	
Observations	138549		68873		121694		61368	
R-squared	0.20		0.22		0.21		0.26	

*Note: All control variables for children and school's characteristics and SES used. Robust standard errors are reported in parenthesis. Asterisks indicate significance at * 0.1 ** 0.05 *** 0.01levels, respectively.*

Looking at the choice at k-stage 4, the general conclusions are that (i) grades affect subjects' choice more at k-stage 5 than a- k-stage 4 and that (ii) at k-stage 4 gender identity

[23]Full results are available in the Appendix (Table A7e).

[24] I relax the linearity assumption using dummies tertiles of Math and English grades. As for the model at k-stage 5, I test formally the null hypothesis that the coefficients estimated through OLS are the same as the ones estimated by the consistent fixed effects estimator and I reject the null hypothesis at 1%.

affects only girls' choices. Considering English as a traditionally female subject and Math as a traditionally male subject, at k-stage 4 boys are not reluctant to enrol in more female subjects if they are good at them. They choose their specialization according with their skills. Conversely girls' choices are strongly stereotyped. On average, girls' *masculinity z-score* is not significantly affected by their Math grade while it is strongly influenced by their grade in English. Only those girls who are really good in Math are disposed to face an identity loss. During k-stage 4 girls' behaviour cannot be explained looking exclusively at their attainments.

9. Conclusions and discussion

This paper provides a framework to comprehend why talented girls choose educational careers leading to low-paid jobs. The main question debated in literature is whether this apparent incongruence is due to nature or nurture. 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 field which usually are associated with higher earning and more prestigious position in the labour market.

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 k-stage 4, when students have to choose for the first time. Especially girls have a stereotypical view of subjects like mathematics which is traditionally considered a male subject while boys are still open to select the subjects on the basis of their ability instead of follow a stereotyped path.

At the following k-stage, gender stereotypes became prominent in educational choices for both girls and boys but still matters more for girls than for boys. 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-linked stereotype. Boys tend to choose more traditionally male subjects and girls more traditionally female subjects.

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. More generally, the no pecuniary pay-off is the lowest for the best students and the highest for the worst ones. The cost associated to behave against gender stereotypes causes a relatively higher utility loss for those students who are not good enough in the opposite sex stereotyped subjects.

Furthermore, I find evidences that attending a single-sex school alleviates gender stereotypes burden for girls at k-stage 5. 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.

The reason leading boys and girls to heterogeneous choices is unveiled also comparing different ethnic groups. Gender stereotypes differ across ethnic groups presumably due to cultural differences and different gender roles.

This research represents a step further in the comprehension on the impact of identity on educational choice. It suggests interesting insights in the debate on the nature or nurture origin of gender segregation in education, analysing the timing of gender stereotypes activation. Girls follow gender roles already when they are aged 14 while gender stereotypes starts affecting boys' choices more consistently at k-stage 5. This analysis permits to exclude that nature is the only responsible. I found that girls in single-sex school behaviour diversely than girls in mixed schools. Studying in absence of the opposite sex alleviates the gender role's pressure and makes them free to choose on the basis of their abilities and not on what the choice makes them appear. In this scenario nurture is the mechanism leading to segregation.

Effective policies should be design to eliminate what constrained student's and help them to make the right choice. In order to attenuate the gendered educational segregation, policies improving either schooling or attainments do not result to be effective if at the origin of gender segregation there is a problem of choice instead of low performance. As I found that gender issues may be different for students achieving different levels of performance, policies may worthwhile target different groups of students in a separate way. Additionally, 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 that the reorganization of the coeducational system into a complete sex segregated system can increase the human capital with no additional expenditure.

References

Akerlof, G. A. and R. E. Kranton (2000), "Economics and Identity", Quarterly Journal of Economics 115 (3): 715-753.

______(2002), "Identity and Schooling: Some Lessons for the Economics of Education", Journal of Economic Literature 40(4): 1167-1201.

______(2005), "Identity and the Economics of Organizations", Journal of Economic Perspectives 19(1): 9-32.

Becker G.S.(1964), "Human Capital: A Theoretical and Empirical Analysis, with Special Reference to Education", Chicago, University of Chicago Press.

Bénabou R., and J. Tirole, (2007), "Identity, Dignity and Taboos: Beliefs as Assets", IZA Discussion Papers 2583, Institute for the Study of Labor (IZA).

Ben Porath Y. (1967), "The Production of Human Capital and the Life Cycle of Earnings." Journal of Political Economy, 75(4), pp. 352-365.

Billger, S. M, (2002), "Admitting Men into a Women's College: A Natural Experiment", Applied Economics Letters, Taylor and Francis Journals, vol. 9(7), p.479-83.

Booth A. and P. Nolen (2009), "Gender Differences in Risk Behaviour: Does Nurture Matter?", IZA Discussion Paper 4026

Browne, N and C. Ross, (1991), "Girls' stuff, boys stuff: young children talking and playing", in: N. Browne (Ed.) Science and Technology in the Early Years (Buckingham, Open University Press).

Francis, B., (2000), "The Gender Subject- Students' Subject Preferences and Discussions of Gender and Subject Ability", Oxford Review of Education, 26(1): 35-48.

Gronau, R. (1974). "Wage comparisons-a selectivity bias", Journal of Political Economy, 81, 1119–1143.

Haag, P. (1998), "Single-sex education in grade K-12: What does the research tell us?" In S. Morse (ed) `Separated by sex: A critical look at single-sex education for girls' American Association of University Women Educational Foundation, Washington DC.

Heckman, J. (1974), "Shadow Prices, Market Wages and Labor Supply." Econometrica 42(4):679-94.

Humlum, M.K., Kleinjans K.J., (2007),"An Economic Analysis of Identity and Career Choice", IZA DP No. 3120.

Jackson, Matthew O. (2009), Social and Economic Networks, Princeton University Press, Princeton

Jackson, C. Kirabo (2011), "Single-sex schools, student achievement, and course selection: Evidence from rule-based student assignments in Trinidad and Tobago", NBER Working Paper Series, Working Paper 16817.

Lee, L.-F., (2000). "Self-selection." In: Baltagi, B.H. (Ed.), A Companion to Theoretical Econometrics. Blackwell, Oxford (Chapter 18).

Lenroot, Rhoshel K., et al. (2007). "Sexual dimorphism of brain developmental trajectories during childhood and adolescence." NeuroImage 36 (2007): 1065–1073.

Levine, J. M. (1989). "Reaction to Opinion Deviance in Small Groups", in P. Paulus, ed., Psychology of Group Influence. 2nd. ed. Hillsdale, NJ: Erlbaum, 1989, pp. 187-231.

Lewis, H. G. (1974). "Comments on selectivity bias in wage comparisons". Journal of Political Economy, 82(6), 1145–1155.

Lokshin M, Sajaia Z (2004). "Maximum likelihood estimation of endogenous switching regression models", Stata J 4(3):282–289

Kanter, R. M. (1977), "Some effects of proportions on group life: Skewed sex ratios and responses to token women. American Journal of Sociology 82:965-90.

Killgore W.D., D. A. Yurgelun-Todd (2004). "Sex related developmental differences in the lateralized activation of the prefrontal cortex and the amygdala during the perception of facial affect." Perceptual and Motor Skills 99 (2004): 371- 391.

Kurtz-Costes, B., Rowley, S. J., Harris-Britt, A., & Woods, T. A. (2008), "Gender stereotypes about mathematics and science and self-perceptions of ability in late childhood and early adolescence", Merrill Palmer Quarterly, 54, 386-409.

Maddala G.S., (1983) "Limited dependent and qualitative variables in econometrics", Cambridge University Press, New York.

Mael, F. A., A. Alonso, D. Gibson, K. Rogers and M. Smith, (2005), "Single-sex versus coeducational schooling: A systematic review". U.S. Department of Education, Office of Planning, Evaluation and Policy Department, Policy and Program Studies Service.

Mincer J.A. (1974), "Schooling, Experience, and Earnings", Published by Columbia University Press.

Mokhtarian, P.L., Cao, X. (2007), "Examining the impacts of residential self-selection on travel behaviour: A focus on methodologies", Transportation Research Part B 42 (2008) 204–228.

Noe', C., (2010), "Family background and female's choice of male's subjects: Evidence from Italy", ChilD 01/2010.

Quandt, R., (1972), "Methods for Estimating Switching Regressions." Journal of the American Statistical Association 67 (338): 306–10.

Rogers, S.J. and E. G. Menaghan, (1991), "Women's Persistence in Undergraduate Majors: The Effects of Gender-Disproportionate Representation", Gender and Society, Vol. 5, No. 4, pp. 549-564.

Roy A.D. (1951), "Some Thoughts on the Distribution of Earnings," Oxford Economic Papers Vol. 3, 1951, pp. 135-146.

Schneeweis, N. and M. Zweimüller, (2009), "Girls, Girls, Girls: Gender Composition and Female School Choice", NRN working papers 2009-05, The Austrian Center for Labor Economics and the Analysis of the Welfare State, Johannes Kepler University Linz, Austria.

Shamai, S. (1994), "Possibilities and limitations of a gender stereotypes intervention program", Adolescence; 29(115):665-80.

Solnick, S. J. (1995), "Changes in women's majors from entrance to graduation at women's and coeducational colleges', Industrial and Labor Relations Review 48(3), 505{514.

Stables, A. (1990), "Differences between pupils from mixed and single-sex schools in their enjoyment of school subjects and in their attitudes to science and to school", Educational Review 42(3), 221{230.

Staw, B. M. (1976). "Knee-deep in the big muddy: A study of escalating commitment to a chosen course of action". Organizational Behavior & Human Decision Processes, 16(1), 27–44.

Tidball, M. E. 1985. Baccalaureate origins of entrants into American medical schools. Journal of Higher Education, 56: 385-402.

Tidball, M. E. 1986. Baccalaureate origins of recent natural science doctorates. Journal of Higher Education, 57: 606-620.

Turner, J. C. (1991), "Social Influence". Pacific Grove, CA: Brooks/Cole, 1991.

Van de Werfhorst, H.G., Sullivan, A. and Cheung, S.Y. (2003), "Social Class, Ability and Choice of Subject in Secondary and Tertiary Education in Britain", British Educational Research Journal, 29: 41-66.

Wikeley, F. and A. Stables, (1999), "Changes in school students' approaches to subject option choices: a study of pupils in the West of England in 1984 and 1996", *Educational Research*, 41, 287-299.

Wilder, G. and Powell, K. (1989), "Sex differences in Test Performance: A survey of the Literature", New York: College Board Publications.

Wooldridge, J.M. (2002). "Econometric Analysis of Cross Section and Panel Data". Cambridge, MA: MIT Press

Appendix

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. In general, secondary schools cater for pupils aged 11 to 16 (k-stages 3 and 4) or 11 to 18+ years (including also k-stage 5), and pupils usually transfer from primary education at the age of 11.

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. They have been designed to enable young people and adults to take part in a full-time or part-time programme of study enabling them to enter employment or further/higher education. 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.

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. Other courses, for example, those leading to A-levels in Applied Subjects may have different admissions requirements.

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	MusicTechnology	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)

Table A2b. Curriculum composition by subjects and courses-per-subjects at k-stage 4

	Number of grades achieved during k-stage 4									
	Girls					*Boys*				
	0	*1*	*2*	*3*	*4*	*0*	*1*	*2*	*3*	*4*
Subjects' categories										
Mathematics	0.816	0.167	0.017	.	.	0.688	0.272	0.039	0.001	.
Science	0.723	0.148	0.112	0.017	.	0.617	0.209	0.140	0.034	.
Economics	0.852	0.134	0.013	0.001	.	0.736	0.228	0.034	0.002	.
Design and Technology	0.947	0.051	0.002	.	.	0.915	0.082	0.003	.	.
Health	0.985	0.015	.	.	.	0.999	0.001	.	.	.
ICT	0.963	0.037	0.000	.	.	0.888	0.111	0.002	.	.
Humanities	0.263	0.380	0.253	0.089	0.014	0.351	0.372	0.200	0.065	0.011
Languages	0.875	0.108	0.017	0.001	.	0.923	0.068	0.009	.	.
Art	0.611	0.279	0.091	0.019	0.001	0.715	0.214	0.059	0.012	0.001
English	0.601	0.381	0.017	.	.	0.787	0.205	0.008	.	.
	Total number of grades achieved during k-stage 4									
	Girls					*Boys*				
	1	*2*	*3*	*4*	*5 (or more)*	*1*	*2*	*3*	*4*	*5 (or more)*
	10.97	14.84	32.86	30.47	10.81	11.8	15.86	31.69	29.82	10.79

Note. Rows sum to 1, except for Mathematics, Sciences, Humanities and Arts where there is a small percentage of students taking more than 3/4 grades for each subject's category.

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 3a), by ethnic groups (Table A3b) and for single-sex and mixed schools (Table 3c) 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	Min	Max	Mean	Std.Dev	Min	Max	Mean	Std.Dev	p-value
School's caractheristics (ks5)											
% of pupils taking FSM	5.33	(0.019)	0.0	100.0	4.91	(0.019)	0.0	100.0	0.420	(0.027)	***
% of pupils with statement for SEN	1.52	(0.007)	0.0	100.0	1.61	(0.009)	0.0	100.0	-0.091	(0.011)	***
% of pupils English not first language	9.07	(0.044)	0.0	99.5	8.01	(0.042)	0.0	99.5	1.063	(0.061)	***
% of Whites	66.74	(0.102)	0.0	99.5	65.18	(0.111)	0.0	100.0	1.564	(0.151)	***
% of Bangladeshi/Pakistani	2.78	(0.024)	0.0	95.3	2.18	(0.019)	0.0	90.3	0.603	(0.031)	***
% of Chinese	2.71	(0.019)	0.0	10.2	2.63	(0.020)	0.0	91.5	0.073	(0.028)	***
% of Indian	0.49	(0.002)	0.0	91.5	0.48	(0.003)	0.0	10.2	0.013	(0.004)	***
% of Caribbean Black	1.14	(0.009)	0.0	37.7	0.96	(0.008)	0.0	37.7	0.176	(0.012)	***
% of African Black	2.04	(0.014)	0.0	49.4	1.71	(0.013)	0.0	49.4	0.334	(0.019)	***

Note: SEN= Special Educational Needs; FSM=Free School Meals Eligibility

Table A3b. Comparing ethnic groups

Panel A. Sample description

	Whites N(286,372)		Bangladeshi/ Pakistani N(13,077)		Diff=(W-B)		t test	Chinese N(2,719)		Diff=(W-C)		t test
	Mean	Std.Dev	Mean	Std.Dev	Mean	Std.Dev	p-value	Mean	Std.Dev	Mean	Std.Dev	p-value
Child's carac.												
Gender	0.47	(0.001)	0.46	0.004	0.01	(0.004)	**	0.49	(0.010)	-0.018	0.010	*
Age	16.68	(0.001)	16.82	0.006	-0.14	(0.006)	***	16.79	(0.013)	-0.115	0.012	***
English lang.	0.98	(0.000)	0.14	0.003	0.84	(0.001)	***	0.23	(0.008)	0.747	0.003	***
GIFT	0.22	(0.001)	0.16	0.003	0.07	(0.004)	***	0.27	(0.009)	-0.045	0.008	***
SEN	0.05	(0.000)	0.07	0.002	-0.02	(0.002)	***	0.08	(0.005)	-0.026	0.004	***
SES	0.14	(0.000)										
IDACI (ks5)	0.04	(0.000)	0.36	0.002	-0.22	(0.001)	***	0.22	(0.004)	-0.081	0.003	***
FSM	0.05	(0.000)	0.35	0.004	-0.31	(0.002)	***	0.09	(0.006)	-0.049	0.004	***
Single-sex												
in ks3	0.13	(0.001)	0.25	0.004	-0.12	(0.003)	***	0.22	(0.008)	-0.086	0.007	***
in ks4	0.14	(0.001)	0.26	0.004	-0.13	(0.003)	***	0.24	(0.008)	-0.101	0.007	***
in ks5	0.11	(0.001)	0.15	0.003	-0.04	(0.003)	***	0.24	(0.008)	-0.130	0.006	***

	Indian N(13,438)		Diff=(W-I)		t test	Black Caribbean N(4,769)		Diff=(W-BC)		t test	Black African N(8,555)		Diff=(W-BA)		t test
	Mean	Std.Dev	Mean	Std.Dev	p-value	Mean	Std.Dev	Mean	Std.Dev	p-value	Mean	Std.Dev	Mean	Std.Dev	p-value
Child's carac.															
Gender	0.49	(0.000)	-0.02	(0.004)	***	0.38	(0.007)	0.09	(0.007)	***	0.43	(0.010)	0.04	(0.005)	***
Age	16.75	(0.010)	-0.08	(0.005)	***	16.87	(0.010)	-0.19	(0.009)	***	16.84	(0.010)	-0.16	(0.007)	***
English lang.	0.25	(0.000)	0.73	(0.001)	***	0.95	(0.003)	0.03	(0.002)	***	0.43	(0.010)	0.55	(0.002)	***
GIFT	0.18	(0.000)	0.04	(0.004)	***	0.16	(0.006)	0.07	(0.007)	***	0.12	(0.000)	0.10	(0.005)	***
SEN	0.05	(0.000)	0.01	(0.002)	***	0.10	(0.005)	-0.05	(0.004)	***	0.10	(0.000)	-0.04	(0.003)	***
SES															
IDACI (ks5)	0.23	(0.000)	-0.09	(0.001)	***	0.36	(0.003)	-0.22	(0.002)	***	0.39	(0.000)	-0.25	(0.002)	***
FSM	0.08	(0.000)	-0.04	(0.002)	***	0.19	(0.006)	-0.14	(0.003)	***	0.28	(0.010)	-0.23	(0.003)	***
Single-sex															
in ks3	0.19	(0.000)	-0.06	(0.003)	***	0.26	(0.006)	-0.13	(0.005)	***	0.26	(0.000)	-0.13	(0.004)	***
in ks4	0.20	(0.000)	-0.07	(0.003)	***	0.27	(0.006)	-0.14	(0.005)	***	0.28	(0.000)	-0.15	(0.004)	***
in ks5	0.17	(0.000)	-0.06	(0.003)	***	0.11	(0.005)	0.00	(0.005)		0.15	(0.000)	-0.04	(0.003)	***

Note: SEN= Special Educational Needs; IDACI= Income Deprivation Affecting Children Index; FSM=Free School Meals Eligibility, W=White; B=Bangladeshi/Pakistani; C=Chinese, I=Indian; BC=Black Caribbean; BA=Black African

Panel B. School's characteristics

	Whites N(286,372) Mean	Std.	Min	Max	Bangladeshi/Pakistani N(13,077) Mean	Std.	Min	Max	Diff=(W-B) Mean	Std.	t test p-value	Chinese N(2,719) Mean	Std.	Min	Max	Diff=(W-C) Mean	Std.	t test p-value
School's carac.																		
% taking FSM	5.27	(0.01)	0.0	100.0	14.98	(0.16)	0.0	71.4	-9.72	(0.074)	***	6.45	(0.19)	0.0	71.4	-1.18	(0.127)	***
% with SEN	1.75	(0.01)	0.0	100.0	1.88	(0.03)	0.0	100.0	-0.14	(0.035)	***	1.60	(0.04)	0.0	100.0	0.15	(0.067)	***
% English lang.	6.51	(0.02)	0.0	90.4	39.15	(0.37)	0.0	97.3	-32.64	(0.142)	***	15.38	(0.41)	0.0	97.3	-8.87	(0.230)	***
% of Whites	85.19	(0.05)	0.0	100.0	42.25	(0.39)	0.0	98.8	42.94	(0.242)	***	69.80	(0.63)	0.0	98.8	15.39	(0.434)	***
% of Banglad./Pak.	1.62	(0.01)	0.0	90.9	25.45	(0.36)	0.0	95.3	-23.84	(0.086)	***	3.80	(0.18)	0.0	95.3	-2.18	(0.096)	***
% of Chinese	1.91	(0.01)	0.0	59.2	8.92	(0.16)	0.0	59.2	-7.01	(0.063)	***	4.68	(0.19)	0.0	59.2	-2.77	(0.104)	***
% of Indian	0.52	(0.00)	0.0	10.2	0.69	(0.01)	0.0	10.2	-0.17	(0.010)	***	1.65	(0.05)	0.0	10.2	-1.13	(0.019)	***
% of Carib. Black	0.79	(0.01)	0.0	37.7	2.66	(0.05)	0.0	37.7	-1.87	(0.030)	***	1.80	(0.09)	0.0	37.7	-1.01	(0.053)	***
% of African Black	1.44	(0.01)	0.0	49.3	4.88	(0.08)	0.0	41.4	-3.43	(0.046)	***	3.64	(0.14)	0.0	49.4	-2.20	(0.082)	***

	Indian N(13,438) Mean	Std.	Min	Max	Diff=(W-I) Mean	Std.	t test p-value	Black Caribbean N(4,769) Mean	Std.	Min	Max	Diff=(W-BC) Diff.		t test p-value	Black African N(8,555) Mean	Std.	Min	Max	Diff=(W-BA) Mean	Std.	t test p-value
School's carac.																					
% taking FSM	8.60	(0.08)	0.0	61.4	-3.33	(0.061)	***	12.12	(0.21)	0.0	61.4	-6.86	(0.125)	***	12.89	(0.17)	0.0	72.0	-7.63	(0.088)	***
% with SEN	1.69	(0.01)	0.0	10.9	0.05	(0.030)	***	2.08	(0.04)	0.0	10.9	-0.33	(0.065)	***	2.04	(0.04)	0.0	99.6	-0.29	(0.044)	***
% English lang.	32.35	(0.27)	0.0	99.5	-25.84	(0.121)	***	27.24	(0.47)	0.0	99.5	-20.73	(0.230)	***	28.73	(0.35)	0.0	97.3	-22.22	(0.163)	***
% of Whites	45.98	(0.32)	0.0	99.4	39.22	(0.210)	***	49.06	(0.59)	0.0	99.4	36.13	(0.429)	***	51.49	(0.43)	0.0	99.4	33.70	(0.297)	***
% of Banglad./Pak.	8.54	(0.11)	0.0	86.0	-6.92	(0.050)	***	5.51	(0.20)	0.0	59.0	-3.89	(0.095)	***	5.59	(0.16)	0.0	95.3	-3.97	(0.068)	***
% of Chinese	18.56	(0.19)	0.0	91.5	-16.66	(0.064)	***	6.33	(0.22)	0.0	91.5	-4.42	(0.104)	***	4.86	(0.13)	0.0	59.2	-2.95	(0.072)	***
% of Indian	0.92	(0.01)	0.0	10.2	-0.40	(0.009)	***	0.84	(0.03)	0.0	10.2	-0.32	(0.019)	***	0.91	(0.02)	0.0	10.2	-0.40	(0.013)	***
% of Carib. Black	2.95	(0.04)	0.0	37.7	-2.16	(0.026)	***	8.39	(0.18)	0.0	37.7	-7.60	(0.055)	***	5.97	(0.11)	0.0	37.7	-5.18	(0.039)	***
% of African Black	4.58	(0.06)	0.0	49.3	-3.14	(0.040)	***	11.34	(0.28)	0.0	49.4	-9.90	(0.085)	***	12.40	(0.19)	0.0	49.4	-10.96	(0.062)	***

Note: SEN= Special Educational Needs; IDACI= Income Deprivation Affecting Children Index; FSM=Free School Meals Eligibility; W=White; B=Bangladeshi/Pakistani; C=Chinese, I=Indian; BC=Black Caribbean; BA=Black African

Table A3c. Comparing Mixed and Single-sex schools

Panel A. Sample description

	Mixed schools N(354,390)		Single-sex schools N(57,514)		Diff.=(M-S)		t test
	Mean	**Std.Dev**	**Mean**	**Std.Dev**	**Mean**	**Std.Dev**	**p-value**
Child's caractheristics							
Age	16.73	(0.001)	16.69	(0.002)	0.04	(0.003)	***
White	0.83	(0.001)	0.75	(0.002)	0.08	(0.002)	***
Bangladeshi/Pakistani	0.04	(0.000)	0.05	(0.001)	-0.01	(0.001)	***
Chinese	0.01	(0.000)	0.02	(0.001)	-0.01	(0.000)	***
Indian	0.04	(0.000)	0.05	(0.001)	-0.02	(0.001)	***
Caribbean Black	0.01	(0.000)	0.01	(0.001)	0.00	(0.001)	
African Black	0.02	(0.000)	0.03	(0.001)	-0.01	(0.001)	***
Others	0.05	(0.000)	0.09	(0.001)	-0.04	(0.001)	***
First language: English	0.89	(0.001)	0.84	(0.002)	0.04	(0.002)	***
Gifted & Talented Cohort (ks5)	0.21	(0.001)	0.24	(0.002)	-0.04	(0.002)	***
SEN (at leats one year ks5)	0.06	(0.000)	0.05	(0.001)	0.00	(0.001)	**
Socioeconomic Status							
IDACI (ks5)	0.17	(0.000)	0.17	(0.001)	-0.01	(0.001)	***
Free school meals (ks5)	0.07	(0.000)	0.06	(0.001)	0.01	(0.001)	***
Single-sex school							
Enrolled in ks3	0.05	(0.000)	0.64	(0.002)	-0.59	(0.001)	***
Enrolled in ks4	0.06	(0.000)	0.88	(0.001)	-0.82	(0.001)	***

Panel B. School's characteristics

	Mixed schools N(354,390)				Single-sex schools N(57,514)				Diff.=(M-S)		t test
	Mean	**Std.Dev**	**Min**	**Max**	**Mean**	**Std.Dev**	**Min**	**Max**	**Mean**	**Std.Dev**	**p-value**
School's caractheristics (ks5)											
% of pupils taking FSM	5.54	(0.015)	0.0	100.0	3.77	(0.027)	0.0	47.5	1.77	(0.031)	***
% of pupils with SEN	1.76	(0.007)	0.0	100.0	0.77	(0.006)	0.0	100.0	0.99	(0.014)	***
% of pupils English not first language	7.93	(0.034)	0.0	99.5	10.58	(0.066)	0.0	97.3	-2.65	(0.072)	***
% of Whites	70.10	(0.083)	0.0	99.5	52.76	(0.159)	0.0	100.0	17.34	(0.174)	***
% of Bangladeshi/Pakistani	2.33	(0.017)	0.0	99.3	3.02	(0.039)	0.0	95.3	-0.70	(0.037)	***
% of Chinese	2.50	(0.016)	0.0	91.5	3.24	(0.025)	0.0	45.1	-0.74	(0.033)	***
% of Indian	0.37	(0.002)	0.0	10.2	0.85	(0.005)	0.0	8.9	-0.47	(0.004)	***
% of Caribbean Black	0.99	(0.006)	0.0	30.3	1.26	(0.014)	0.0	37.7	-0.27	(0.014)	***
% of African Black	1.63	(0.010)	0.0	49.4	2.68	(0.024)	0.0	49.3	-1.05	(0.022)	***

Note: SEN= Special Educational Needs; IDACI= Income Deprivation Affecting Children Index; FSM=Free School Meals Eligibility; M=Mixed schools; S=Single-sex schools

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**		
K-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 (k-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 (k-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 reported in parenthesis.

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		
K-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 1 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 Math, 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. Comparing attainments and masculinity score for students from different ethnic groups

Comparing boys' and girls' behaviour within different ethnics groups is the second strategy I used in order to identify groups for which gender identity may works differently. Moreover, the division by ethnicity avoids the possible selection problem rising by single-sex schools sample.

I considered six ethnic groups: Whites, Bangladeshi/Pakistani, Chinese, Indian, Black Caribbean and Black African. In Table 7 I report the attainments in female and male subjects at both k-stage 4 and k-stage 5 and the *masculinity z-score* at both k-stages for the same groups of students.

Let compare attainments and *masculinity score* across ethnic groups. Ordering the ethnic groups on the basis of attainments in male and female subjects, lead substantially to the same ranking for girls and boys. Chinese are the best students and Black Caribbean the worst in both female and male subjects. In k-stage 4 girls are always better than boys both in male and female subjects and they are relatively better in female subjects than in male subjects within all ethnic group. It is worthwhile to note that only White and Indian boys are relatively better in male than in female subjects.

Whether the attainments in previous k-stage would be the criteria to choose the curriculum at k-stage 5, the same ranking should be expected for the *masculinity z-score*. However, it is not the case. White girls and boys go down in the ranking. In particular, two facts coexist: the hyper specialization of Indian and Chinese girls and the under-specialization of White girls in male subjects.

Table A5a. Attainments and masculinity score at k-stage4 and k-stage 5 comparing students from different ethnic groups

			White	Bangladeshi/ Pakistani	Chinese	Indian	Black Caribbean	Black African
			Attainments, ks4					
Girls	**(1)**	Female subj.	3.80	3.42	4.29	3.79	3.23	3.32
	(2)	Male Subj.	3.78	3.33	4.11	3.73	3.16	3.23
Boys	**(3)**	Female subj.	3.55	3.19	3.94	3.51	3.51	3.10
	(4)	Male Subj.	3.59	3.10	3.82	3.53	2.89	2.98
			Masculinity (z-score), ks5					
Girls	**(5)**		-0.36	-0.11	0.30	0.02	-0.45	-0.17
Boys	**(6)**		0.34	0.57	0.96	0.74	0.21	0.45
Relative advantages								
Within groups		(1)-(2)	0.02	0.09	0.18	0.06	0.07	0.09
		(3)-(4)	-0.04	0.08	0.12	-0.03	0.62	0.12
Across groups		(2)-(4)	0.19	0.23	0.29	0.20	0.27	0.25
Diff. in choice		(5)-(6)	-0.70	-0.68	-0.66	-0.71	-0.66	-0.62

Note: two samples t-tests for a difference *in mean between girls and boys (within the same ethnic groups) results significant at 1 percent for all variables considered (not reported in the table).*

In the bottom part of the Table 7 I report the within-group relative advantage computed as the difference between the attainment in female and male subjects for girls (and boys), the across-groups advantage measuring the difference between girls' and boys' attainments in male subjects. Finally I report the difference in choice as the difference between girl's and boy's *masculinity z-score*. Note that independently by the ethnic group girls and all boys except White and Indian boys are better in female than male subjects. Those with the lowest within-group advantage (1)-(2) for girls and (3)-(4) for boys should be those choosing a more male oriented curriculum. Those with a negative within-group advantage should be those choosing a male oriented curriculum, if they based their choice on attainments.

For example, White and Indian girls should have the highest *masculinity score*. White girls have almost the same grade in female subjects than Indian girls and they have a higher attainment in male subjects. Despite of this, Indian girls' *masculinity score* at k-stage 5 is considerably higher than the White girls. The girls' *masculinity score* is more similar to then Black Caribbean girls who have lower attainments in both female and male subject's but are relatively better in female subjects.

A6. Control variables used (measured at both k-stage 4 and k-stage5)

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