QUALITY OF SCHOOLING AND INEQUALITY OF OPPORTUNITY IN HEALTH

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(Very preliminary – please do not quote)

Abstract

This paper explores the existence of long-term health returns to different qualities of education, and examines the role of quality of schooling as a source of inequality of opportunity in health. It provides corroborative evidence of a statistically significant and economically sizable association between quality of education and a number of health and health-related outcomes. This remains valid over and above the effects of measured ability, social development and academic qualifications. The results do not confirm the generally hypothesised role of lifestyles and sheepskin effects as mediation channels of these relationships. Substantiating earlier literature that links differences in education to health disparities, the results also establish quality of schooling as a leading cause of inequality of opportunity in health. Equalising opportunities in health may require not only longer schooling, but also better quality of schooling.

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Recent empirical work, such as Trannoy et al. (2009) and Rosa Dias (2009), suggests that differences in education are a leading cause of inequality of opportunity in health. This is in line with the earlier literature on socioeconomic inequalities in health, such as Wagstaff, van Doorslaer and Watanabe (2003) and van Doorslaer and Jones (2003), and agrees with the large body of evidence emphasising the role of complementary educational policies in reducing long-run health inequalities.

The issue of complementary policies has been brought to the fore in various fields of economics; the reciprocal association between health and education policy has attracted particular attention. First, the way childhood health constitutes a pre-requisite for the success of educational policy is well documented in empirical papers such as Mayer-Foulkes (2001), Miguel (2005), Alderman et al (2006), Contoyannis and Dooley (2010), in the official guidelines of policy makers (for example the World Food Program (2006)) and in theoretical models of child nutrition and human capital formation, such Currais et al. (2010) and De la Croix and Doepke (2003). Second, the fact that education is a vital input in the health production function has been established by papers such as Lleras-Muney (2005), Arendt (2005; 2008), Oreopoulos (2006), Silles (2009) and Van Kippersluis et al. (2009); these provide evidence of the existence of positive long term health effects of successive increases in the number of years of compulsory education in Europe and in the USA.

Cutler and Lleras-Muney (2010) recently added to this body of evidence by carrying out an empirical assessment of the most common explanations for the relationship between years of schooling and the wide disparities observed in individual health related behaviours. Nonetheless, this literature leaves important questions unanswered. One of such questions underlined in Cutler and Lleras-Muney (2008, p.22), concerns the existence of health returns to different qualities of education. This is a topical policy issue, since evidence on the existence of such returns is vital to inform the design of complementary policy interventions connecting the educational and the healthcare sectors. This paper seeks to narrow this gap. We adapt the empirical strategy put forward by Cutler and Lleras-Muney (2010) to examine the association between quality of schooling, lifestyle and health inequalities in adulthood. This is done by exploiting the wide variation in quality of the

primary and secondary schools attended by cohort-members of the National Child Development Study (NCDS). We address three main issues:

- The existence of a statistical association between quality of schooling and health and lifestyle in adulthood.
- The identification of channels that mediate this association.
- The extent to which, from a normative standpoint, there is inequality of opportunity in health by quality of education among NCDS cohort-members.

The NCDS cohort-members' educational experience has some distinct features, both at primary and secondary levels. To begin, some of them attended state primary schools while others went to private primary schools; these schools were typically different in terms of available resources, peer effects, and curricula. Nonetheless, the main source of variability in the cohort members' quality of schooling relates to the very different types of secondary schools attended. This is mainly due to the fact that the cohort's secondary schooling years lay within a transition period corresponding to the major comprehensive schooling reform, implemented in England and Wales[1]. The reform was not introduced simultaneously nationwide. Some pupils were unaffected by it and attended the pre-existing, highly selective state-funded tri-partite system, which comprised grammar schools, secondary modern schools and a small and declining number of technical schools. The majority of the cohort was affected by the reform and attended comprehensive schools. Also, a minority of NCDS cohort went to private fee-paying schools, independent of the state schools educational systems and reforms. The distribution of the NCDS cohort members by type of secondary school is shown in Figure 1.

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[1] Data on Scotland are not used: the Scottish educational system of the 1960's and 1970's was structurally very different from the one experienced by all the other NCDS cohort-members, and comprehensive schooling was introduced earlier, preventing a legitimate comparison of types of school, educational qualifications and outcomes.

1. Quality of schooling

1.1 Primary education

Table 1 shows the breakdown of the type of primary education experienced by the NCDS cohort-members, by type and characteristics of the schools. The mean pupil-teacher ratios were different between state and private schools and their distributions were markedly different, as made clear in Figure 2, which contrasts state with private primary schools. The effect of these differences on educational attainment and wages was examined using NCDS data by Dearden, Ferri and Meghir (2005); however, its effect on health-related behaviours and outcomes have not been taken into account by the existing literature.

1.2 Secondary education: the comprehensive reform and equality of opportunity

As shown in Figure 1, nearly 40 per cent of the state schools students were not affected directly by the reform and attended the tri-partite system of state-funded education. Grammar schools were academically oriented state schools that provided teaching for the entire age range 11-18, including a sixth form for Advanced level ('A-level') studies, and prepared pupils to go on to higher education. Admission into these schools was determined by an exam taken at age 11 (the 'Eleven Plus' exam). Pupils whose examination score did not permit entry into a grammar school went to secondary modern schools, which were also state schools, but less academically oriented and covered the ages 11-16 or, in a small minority of cases, vocational schools aimed at providing training and technical apprenticeships[2].

A substantial share of the cohort members were affected by the reform, which was explicitly designed to promote equality of opportunity between children of different parental backgrounds. The reform replaced the selective educational system (both grammar and secondary modern schools) by a unified mixed ability secondary schools system ("comprehensive schools") [3]. The types of schools were substantially different in their curriculum, examinations and academic environment and peer effects. Table 2 shows that,

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[2] In a few cases, pupils whose grades were sufficient transferred to grammar schools or sixth form colleges to complete their A-levels.

[3] Following much controversy over the Eleven Plus, the selective system went into decline in the 1960's and 1970s, until it was abolished in England and Wales by the 1976 Education Act. The selective system has persisted in certain areas, such as Kent.

among the schools attended by the NCDS cohort members at age 16, 79 per cent of private schools and 68 per cent of grammar schools were single sex, while only 13 per cent of comprehensives were single sex. Streaming of classes by academic ability was common in secondary moderns and comprehensives but rare among grammar schools. Some comprehensives were former secondary moderns (18 per cent) or grammar schools (25 per cent) with rest being newly created. Furthermore, the distribution of the pupil-teacher ratio also differs considerably across these four types of schools as shown in Figure 3.

2. Data

The National Child Development Study (NCDS) follows a cohort of nearly 17,000 individuals, who were born in Great Britain in the week of 3rd March 1958, from birth up until age 46. Seven waves of interviews have been carried-out when cohort members were 7, 11, 16, 23, 33, 42 and 46 years old. The study compiles in-depth information on the cohort-members' childhood health and parental background. It comprehensively records cognitive ability and social development in childhood and adolescence, and, crucially for this paper, quality of schooling at primary and secondary levels together with overall educational achievement. It also includes measures of social status in adulthood, and detailed information on health-related behaviours and health outcomes in adulthood.

2.1 Childhood health, parental background and neighbourhood characteristics

The NCDS data include extensive information on the cohort-members' early health endowments. In order to control for these we have constructed morbidity measures that aggregate twelve categories of health conditions affecting the child at ages 7 and 11 (following Power and Peckham, 1987). We have also created indicator variables for the occurrence of diabetes, epilepsy and other chronic conditions in parents and siblings in order to account for the incidence of hereditary conditions in the cohort members' family. NCDS data on the height and weight of the cohort-members also allows us to control for the long-term impact of obesity in childhood and adolescence.

In terms of parental background, the NCDS allows us to trace the social class and the years of schooling of both parents of the cohort members. Following Case et al. (2005) and Lindeboom et al. (2009), we have complemented this information with data on the

incidence of household financial difficulties during the cohort member's childhood and adolescence.

The NCDS also includes rich information about the socioeconomic characteristics of the cohort-members' neighbourhood during childhood and adolescence. For the years of 1971 and 1981, NCDS survey data was linked to census data[4]; this makes it possible to use census enumeration district level data (the smallest unit for which census statistics are available with an average population of about 460) to control for geographic heterogeneity in the individual's immediate social milieu.

2.2 Cognitive ability, social development and educational achievement

The NCDS is rich in measures of cognitive and social development prior to secondary schooling. Scores of ability tests taken at ages 7 and 11 are available on a series of cognitive dimensions: mathematics, reading, copying designs and general ability. Since test scores are highly correlated, hence leading to multicollinearity in econometric models, we follow Galindo-Rueda et al. (2005) and use principal components analysis to construct a single measure of cognitive ability using the first principal component. We use as controls both the individuals' measure of cognitive ability and their relative rank in the distribution of cognitive ability of their peers.

Social development has received growing attention as an explanatory factor for behaviour, competence and achievement in adulthood. Following Carneiro et al. (2007) the score for the Bristol Social Adjustment Guide (BSAG) is used as a measure of social development at age 11: teachers are asked whether the child has problems in twelve behavioural domains such as hostility towards children and adults, anxiety, withdrawal, 'writing off' adults, unforthcomingness, depression, restlessness, acceptance by adults, inconsequential behaviour and miscellaneous psychological and nervous symptoms. One point is attributed to each positive answer; points are then summed to obtain the BASG social maladjustment score. The distribution of both cognitive and non-cognitive ability measure is shown in Figure 4.

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[4] This small are data are available under a special licence, which imposes restrictions on the handling and usage of the data. Details can be found at http://www.cls.ioe.ac.uk/studies.asp?section=0001000200030015.

The NCDS also includes information on the educational attainment and qualifications awarded to cohort members: no formal qualifications; Certificates of Secondary Education (CSE), O-levels, A-levels and university degree or equivalent[5]. We further disaggregate this information on educational achievement into twelve categories, ordered according to the grades obtained and number of passes.

2.3 Health-related behaviours, attitudes and outcomes

The NCDS contains self-reported information on a series of health-related lifestyles: cigarettes smoked per day, average units of alcohol consumed per week[6] and dietary choices, such as the frequency of consumption of fried food, vegetables and sweets. These data are only available in the four most recent waves of the study, once respondents are aged 23 and above. We also look at other health-related behaviours among women, such as teenage pregnancy and maternal smoking during pregnancy, susceptible of being affected by qualitative aspects of education.

The effect of quality of schooling is examined for a range of health outcomes in adulthood and late adolescence. The first of these is self-assessed health (SAH), measured on a five-point scale: excellent, good, fair, poor and very poor health. SAH is widely used in health economics and has been shown to predict mortality and deterioration of health even after controlling for the medical assessment of health conditions.

A more specific measure of health in adulthood is the incidence self-reported long standing illness or disability at age 46. Information on the particular medical condition associated with it is available and classified according to the International Classification of Diseases (ICD-10).

Mental health in adulthood is taken into account as a separate outcome: NCDS respondents answer to a series of questions from the Cornell Medical Index Questionnaire,

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[5] CSEs and O-level (Ordinary levels) were secondary education qualifications corresponding, typically, to 11 years of education in total; CSEs were academically less demanding than O-levels. A-levels (Advanced levels) are a qualification which typically corresponds to 13 years of education. Completion of A-levels is ordinarily a prerequisite for university admission.
[6] NCDS respondents are asked about their weekly consumption of a wide range of alcoholic drinks (glasses of wine, pints of beer and so forth). These are then converted to units of alcohol using the UK National Health Service official guidelines that are available at: http://www.nhsdirect.nhs.uk/magazine/interactive/drinking/index.aspx .

each targeting a particular mental ailment; the number of positive answers given at age 42 is then used as a malaise score along the lines of Carneiro et al. (2007).

2.4 Sample selection and non-response

The size of our final estimation samples was significantly affected by attrition and especially by the patterns of item non-response. However, recent papers that analyse NCDS data, such as Case et al. (2005) and Lindeboom et al. (2006), recognise the problem but do not find evidence of non-random attrition. Table 3 contrasts the full NCDS sample with the estimation sample used in our econometric analysis. On average, individuals in the estimation sample come from slightly richer and better-educated backgrounds when compared with the full sample. They score higher than the full sample in ability tests taken at age 11, but do not have systematically better childhood health.

3.   Methods

We first explore the existence of a statistical association between quality of schooling and both health and lifestyle in adulthood, adopting a similar approach to that of Cutler and Lleras-Muney (2009). We then examine the extent to which quality of education is a source of inequality of opportunity in health among NCDS cohort-members.

3.1 Regression analysis

We estimate, for each outcome of interest, a model of the form[7]:

$$\text{health outcome}_{i,age46} = \alpha + \beta_{1,i} * (\text{type and characteristics of school}) + \beta_{2,i} * (\text{childhood health}) +$$

$$+\beta_{3,i} * (\text{ability prior to enrolment}) + \beta_{4,i} * (\text{parental background}) + \beta_{5,i} * (\text{local area / other control variables}) + \varepsilon_i$$

By exploiting the rich set of covariates that are observed prior to enrolment we control for most of the potential confounders of the relationship between quality of schooling and

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[7] Probit models are used to estimate the impact of quality of schooling on the incidence of chronic illness, cigarette smoking, teenage pregnancy and maternal smoking during pregnancy. The models for the Cornell index of mental illness and for the weekly consumption of units of alcohol are linear regressions. For self-assessed health and for the weekly consumption of fried food an ordered probit specification is used. Estimate are presented as partial effects on the outcome of interest.

health in adulthood. While potentially over-controlling, this specification establishes a conveniently stringent test for the statistical significance of the association in question.

We then estimate a sequence of models in order to illuminate three possible mediating channels for this association: academic qualifications; lifestyles; social class / command over resources. The models that account for all of these for each health outcome are of the form:

$$\text{health outcome}_{i,age46} = \alpha + \beta_{1,i} * (\text{type and characteristics of school}) + \beta_{2,i} * (\text{childhood health}) +$$
$$+ \beta_{3,i} * (\text{ability}) + \beta_{4,i} * (\text{parental background}) + \beta_{5,i} * (\text{local area / other control variables}) +$$
$$+ \beta_{6,i} * (\text{highest edu. qualification}_{age42}) + \beta_{7,i} * (\text{lifestyles}_{age33/42}) + \beta_{8,i} * (\text{social class}_{age42}) + \varepsilon_i$$

3.2 Distributional analysis

To examine the role of quality of schooling as a source of inequality of opportunity in health we embed these empirical results in the framework of Roemer (2002); this has been the workhorse in most of the applied literature on inequality of opportunity in health. Roemer (2002) sorts all factors influencing individual attainment between a category of *effort factors*, for which individuals should be held partly responsible for and a category of *circumstance factors*, which, being beyond individual control, are a source of unfair differences in outcomes. In our case, we assume that the type of secondary school in which pupils are enrolled at age 11 is largely beyond their individual control and therefore constitutes a circumstance. Since the outcome of interest is a range of health outcomes in adulthood (*H*) a generalised health production function can be defined along the lines of Roemer (2002) as $H(C, E(C))$, where C denotes individual circumstances and E denotes effort, which is itself a function of circumstances.

Roemer (2002) defines social types consisting of individuals who share exposure to the same circumstances, for example the attendance at the same type of secondary school. Roemer's definition of equality of opportunity is that, on average, all those who exert the same effort should be entitled to equivalent health status, irrespective of their circumstances. Such a situation corresponds to a full nullification of the effect of circumstances, keeping untouched the differences in outcome that are caused solely by effort.

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Denoting by $F(H|C)$ the cumulative distribution function of the health outcome of interest conditional on circumstances, a literal translation of Roemer's notion of inequality of opportunity would mean considering that there is inequality of opportunity whenever: $\forall C \neq C', F(H|C) \neq F(H|C')$. This condition is however too stringent to be useful in empirical work. Lefranc et al. (2009) consider that the data are consistent with the hypothesis of inequality of opportunity if the social advantage provided by different circumstances can be unequivocally ranked by first degree stochastic dominance[8] (FSD), i.e. if the distributions of health conditional on different circumstances can be ordered according to *expected utility*: $\forall C \neq C', F(H|C) \succ_{FSD} F(H|C')$.

We follow this literature, carrying out stochastic dominance tests to detect inequality of opportunity in a series of health outcomes. The testable condition for inequality of opportunity is therefore:

$\forall$ school type A, school type B, $F(H \,|\, \text{school type A}) \succ_{FSD} F(H \,|\, \text{school type B})$.

4. Results

4.1 Quality of schooling, health and lifestyle: primary schools

Table 4 shows the partial effects computed for five alternative specifications for the association between three indicators of primary school quality: private or state school, teacher-pupil ratio, and pupil wellbeing at school, and a series of health-related behaviours and outcomes. The results do not indicate a statistically significant association between schools being privately owned and operated, teacher-pupil ratios, and self-assessed health at age 46. However, the indicator variable for whether pupils were happy at primary school

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[8] A lottery stochastically dominates another if it yields a higher *expected utility*. Several orders of stochastic dominance may therefore be defined according to the restrictions one is willing to make on the individual utility function. First order stochastic dominance (FSD) holds for the whole class of increasing utility functions ($u'>0$); this corresponds to simply comparing *cdfs* of the earnings paid by alternative lotteries. Second order stochastic dominance (SSD) applies to utility functions which are increasing and concave in income, reflecting the notion of risk aversion ($u'>0$ and $u''<0$); SSD evaluates integrals of the *cdfs*. While FSD implies SSD, the converse is clearly not true. SSD cannot be defined for discrete and ordinal outcomes such as the ones used in this paper, hence all definitions and tests refer to FSD.

is a good predictor of health in adulthood: after controlling for parental background, cognitive ability and social development, lifestyle and academic qualifications, dissatisfaction at primary school is associated with a nearly 6 percentage points reduction on the probability of reporting excellent health at age 46. In terms of prevalence of long standing illness and disability, the partial effects of private school indicators and teacher-pupil ratios remain statistically insignificant and generally small. Also, the pattern of large and statistically significant partial effects of unhappiness in primary school persists; their magnitude and precision are however attenuated once the effects of overall educational achievement and social class in adulthood are controlled for (models 4 and 5).

The results for mental illness at age 46 show a different pattern. There is a clear negative and statistically significant association between the teacher-pupil ratio and the prevalence of mental illness in adulthood. The size of the partial effects is roughly constant across models, whence lifestyle choices, educational qualifications and social status in adulthood are not the chief mediators of this relationship. Also, although imprecise, the partial effects of attendance at a private primary school are consistently positive and large in all models[9]. Once more, unhappiness at school is strongly positively associated with the incidence of mental illness at age 46 in all the models considered. Social status in adulthood appears to be an important channel for this association given that partial effects are reduced by nearly 30 percentage points once we control for the effect of social class.

In the models for these three health outcomes, self-reported health, chronic and mental disorders, the magnitude of the estimated partial effects does not change much once lifestyle choices are controlled for, suggesting that health related behaviours do not mediate the effect of quality of primary schooling on health outcomes. This fact is corroborated by the estimates obtained for the models for cigarette smoking and consumption of alcohol and fried food. In almost all cases, the partial effects for the quality of school indicators are statistically insignificant and economically negligible.

The results also provide no evidence of an impact of quality of primary education on the occurrence of teenage pregnancies and on cigarette smoking during pregnancy. Due to the

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[9] Reverse causality may be a possible explanation for this association if, in 1965, mentally troubled children were relatively more likely to benefit from smaller class size and to attend to private schools.

smaller size of the estimation samples for the last two outcomes of Table 4 none of the female cohort-members who attended at private primary school reported to have smoked during their pregnancies; we therefore dropped the indicator for private school from the last model of the table.

4.2 Quality of schooling, health and lifestyle: Secondary schools

Table 5 presents the results for the relationship between quality of secondary education and the same range of outcomes and health-related attitudes considered in section 4.1. The main variables of interest are now indicators for the four types of schools described above (comprehensive schools, secondary modern schools, grammar schools, private schools), school characteristics and resources. The reference category for the comparisons between types of school is attendance at a grammar school, which, on average, is associated with the best health outcomes.

The estimates in the table show no evidence of a statistically significant association between types of schools and SAH at age 46: the negative impact of attendance at secondary modern schools, found in Model 1, disappears after controlling for differences in cognitive ability and social development. The only school characteristic that bears a negative and statistically significant association with SAH at age 46 is the schools' student expulsion rate. This variable is commonly used as a proxy for the school's academic environment and peer effects, which potentially shapes lifestyle and preferences such as risk aversion and subjective valuation of the future. Interestingly, however, the size of its estimated partial effects is relatively constant across the five models, suggesting that its impact on health is not mediated by lifestyles or academic achievement and social status.

The models for the incidence of chronic illness and disability show a different pattern. Attendance at comprehensive and secondary modern schools is associated with a higher incidence of chronic illness or disability than grammar schools. The size of these effects is substantial: nearly 11 per cent higher incidence in the case comprehensives and roughly 8 percentage points higher incidence in the case of secondary moderns, when the full set of controls is included in the model. This constitutes evidence of a large impact of quality of schooling on health, over and above the effect of educational qualifications, ability and lifestyle.

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The association between the attendance at different types of schools and the occurrence of mental illness in adulthood is also sizable and statistically significant. In line with the results obtained for primary education, the partial effect of attendance at private secondary schools is positive and large, after controlling for the entire available set of covariates. The relative constancy of these partial effects across the five models suggests once more that lifestyle quality and academic qualifications are not channels for this relationship. Indicator variables for whether these schools were single-sex schools and boarding schools are not statistically significant. After controlling for cognitive and non-cognitive ability prior to enrolment in secondary schools, attendance at comprehensive schools has a negative partial effect; this ranges between 38 and 50 percentage points, after controlling for the widest set of covariates. The magnitude of these effects is also insensitive to the inclusion of lifestyle choices and overall academic qualifications in the model.

As in Section 4.1 the association between quality of secondary schooling and lifestyles is generally unclear and statistically insignificant, after controlling for measured cognitive ability and social development at age 11. An exception to this pattern is the positive association between attendance at comprehensive schools formed from former secondary moderns and the weekly consumption of fried food: the cohort-members who attended at this type of school are nearly 1 percentage point more likely to consume fried food on a daily basis than those educated in grammar schools.

Attendance at boarding schools is a perfect predictor of the two maternity-related outcomes in Table 5: none of the cohort-members educated in such schools reported either to have been a mother during teenage years or to have ever smoked during pregnancy. After controlling for ability at age 11, the female cohort-members who attended at comprehensive and secondary modern schools are more likely to be pregnant before age 18; however, this association disappears after controlling for academic qualifications. Several qualitative characteristics of secondary schooling are also statistically significantly associated with the probability of maternal smoking during pregnancy. Attendance at comprehensive schools, particularly those formed from secondary modern schools is associated with a nearly 8 percentage points reduction of this probability in Model 5. The existence of a statistically significant association between quality of schooling and this

health-related behaviour is further corroborated by the positive partial effect of the pupil-teacher ratio, which remains statistically significant in all the models. In addition, student expulsion rates are positively associated with maternal smoking during pregnancy, although this relationship becomes statistically insignificant when educational qualifications and social class in adulthood are used as controls in the models.

4.3 Quality of schooling and inequality of opportunity in health

The results so far provide substantial evidence of a statistically significant association between multiple dimensions of quality of schooling and health outcomes. This positions quality of schooling as a potential cause of inequality of opportunity in health.

Within the framework of Roemer (2002) quality of schooling, at both primary and secondary levels, constitutes a circumstance. A general picture of its association with health is patent in Figure 5, featuring the possible pairwise comparisons between the empirical distributions of SAH at age 46 by type of secondary schooling. When we contrast the SAH profiles of individuals who attended secondary modern and grammar schools, the gap between the two empirical distributions is remarkably wide. This is striking since it is attributable to one single circumstance. Conversely, the empirical distributions of SAH for grammar and private schools are very similar; the same happens when we compare the SAH profiles for comprehensive and secondary moderns. Figure 6 features the same type of pairwise comparisons applied to the empirical distributions of the mental illness index at age 46; the gaps are slightly less pronounced, but still striking.

In order to formally assess the existence of inequality of opportunity using the formulation presented in Section 3, Kolmogorov-Smirnov tests for first degree stochastic dominance are carried-out; the statistically significant results at the 1% ignificance level are shown in Table 6. The results for SAH at age 46 establish four statistically significant dominance relationships: the distribution self-assessed health of the cohort members who attended at grammar and private schools dominate the one of those who went to secondary modern and comprehensive schools. For detrimental outcomes, this pattern is reversed: secondary modern schools dominate grammar schools for cigarette smoking and incidence of chronic disease and mental illness and private schools for cigarette smoking and incidence of chronic diseases. Comprehensive schools dominate grammar schools at first order for all

the detrimental outcomes and private schools for cigarette smoking only. These results establish the existence of inequality of opportunity in health and health-related outcomes, favouring the cohort members who attended at grammar and private schools relatively to their counterparts who attended comprehensive and secondary modern schools.

5. Conclusions

We provide evidence of the existence of a long-term association between health returns to different qualities of education, over and above the effects of measured ability, social development, years of schooling and academic qualifications. This association, postulated but not explored in earlier literature, proves to be statistically significant and economically sizable for several important health outcomes and health-related behaviours, after controlling for a rich set of controls.

The impact of the different qualitative dimensions of primary and secondary education is uneven across the set of outcomes of interest. Our measures of quality of primary school education are not significantly correlated either with SAH, or with the occurrence of chronic conditions in adulthood. Conversely, the pupil-teacher ratio in primary schools is strongly and negatively associated with the incidence of mental illness at age 46; also unhappiness at school, interpreted in the paper as a broad measure of adequacy of schooling, is associated with a significant increase in the incidence of mental disorders at age 46 and with a reduction in the probability of reporting excellent health at the same age of about 6 percentage points. This association remains valid after controlling for lifestyle, overall educational achievement, but social status is a possible mediating channel for this relationship since it is linked to a roughly 30 per cent reduction of the measured effect.

The main source of variation in quality of schooling is, in the NCDS, the attendance at very dissimilar types of secondary schools. The association between types of schools and health outcomes is also much stronger than in the case of primary education. Measures of poor quality of schooling, such as the pupil expulsion rate, are positively correlated with a deterioration of SAH in all the estimated models. Attendance at particular types of schools, such as comprehensive and secondary moderns, is associated to a much larger incidence of chronic illness than others, such as grammar schools. Individuals who went to private schools are also associated to a higher prevalence of mental disorders in adulthood than

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those who attended at grammar schools. No evidence was found to confirm the influence of the hypothesised transmission channels of these effects, since these results remain sizable and statistically significant after controlling for health endowments, parental background, ability, lifestyle, educational qualifications and social status in adulthood. One explanation for this is the impracticality of controlling directly for other potentially important transmission mechanisms of the effect of education such as subjective discount rates, risk aversion, information processing capacity, health and health care-related knowledge[10].

Using the analytical framework proposed by Roemer (2002), the paper examines the role of quality of schooling as a source of inequality of opportunity in health. The results show that conditioning solely on the type of secondary school attended by the cohort-members is sufficient to formally establish first order stochastic dominance relationships between the empirical distributions of most of their health outcomes. This suggests that equalising opportunities in health may require not only more education, but also better education.

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Figure 1: NCDS cohort-members by type of school (age 16)
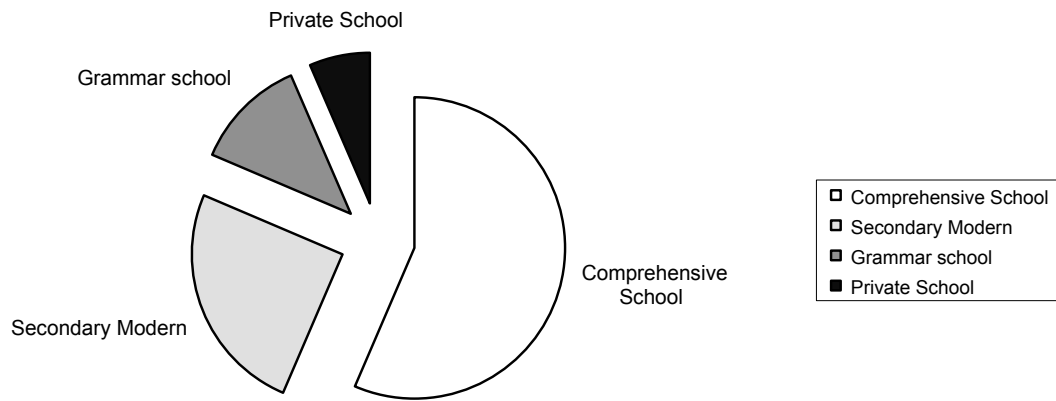
Figure 2: Distribution of pupil-teacher ratios by type of primary school
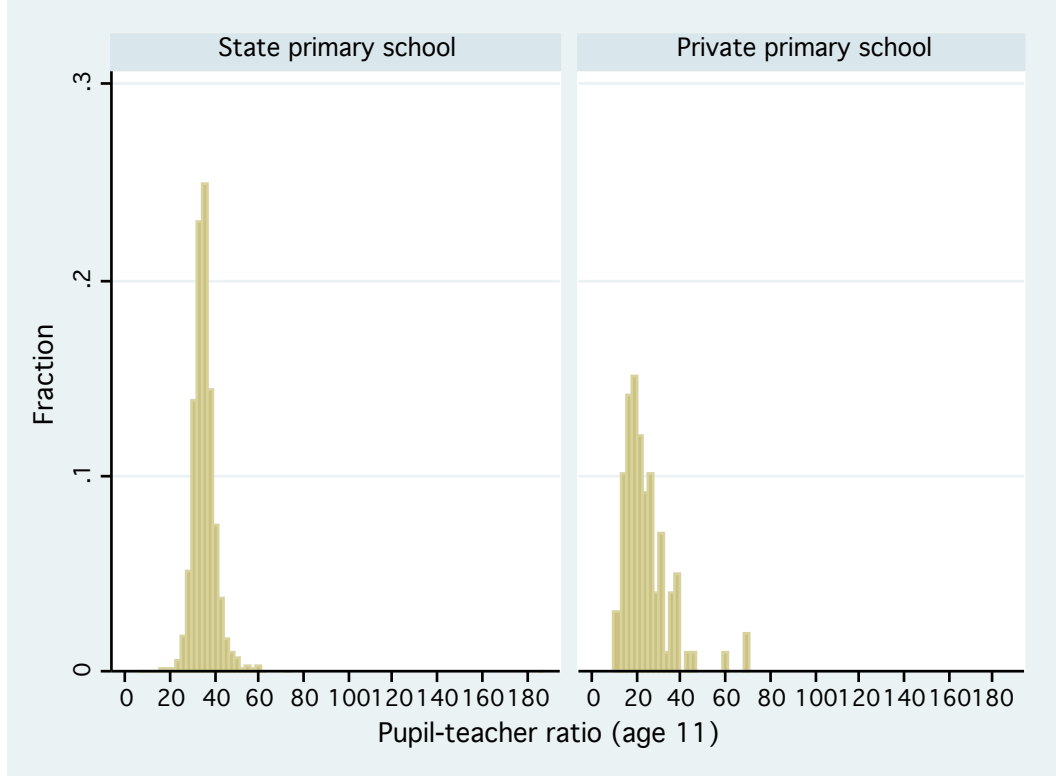
Figure 3: Distribution of pupil-teacher ratios by type of secondary school
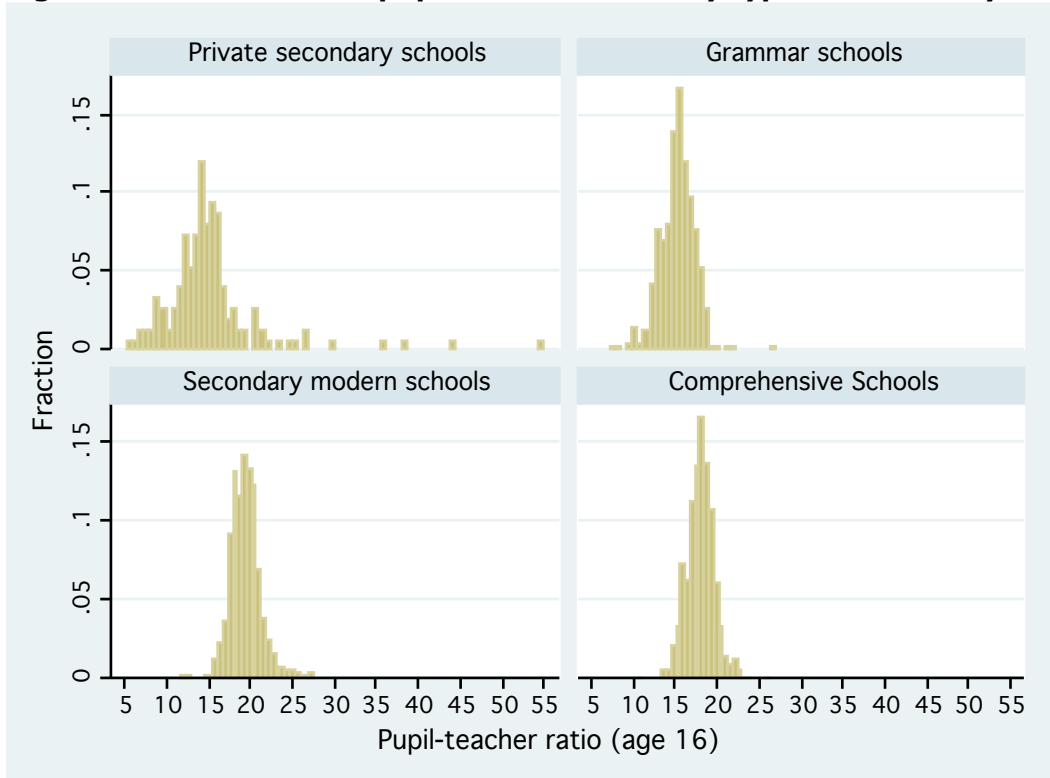
Figure 4: Distribution of cognitive and non-cognitive ability in the NCDS cohort
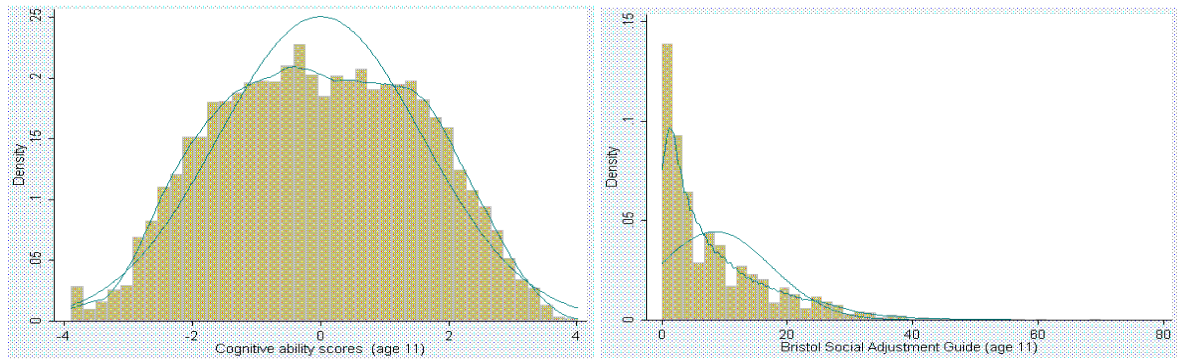
Figure 5: Stochastic dominance: empirical distributions of SAH (age 46) by type of secondary school
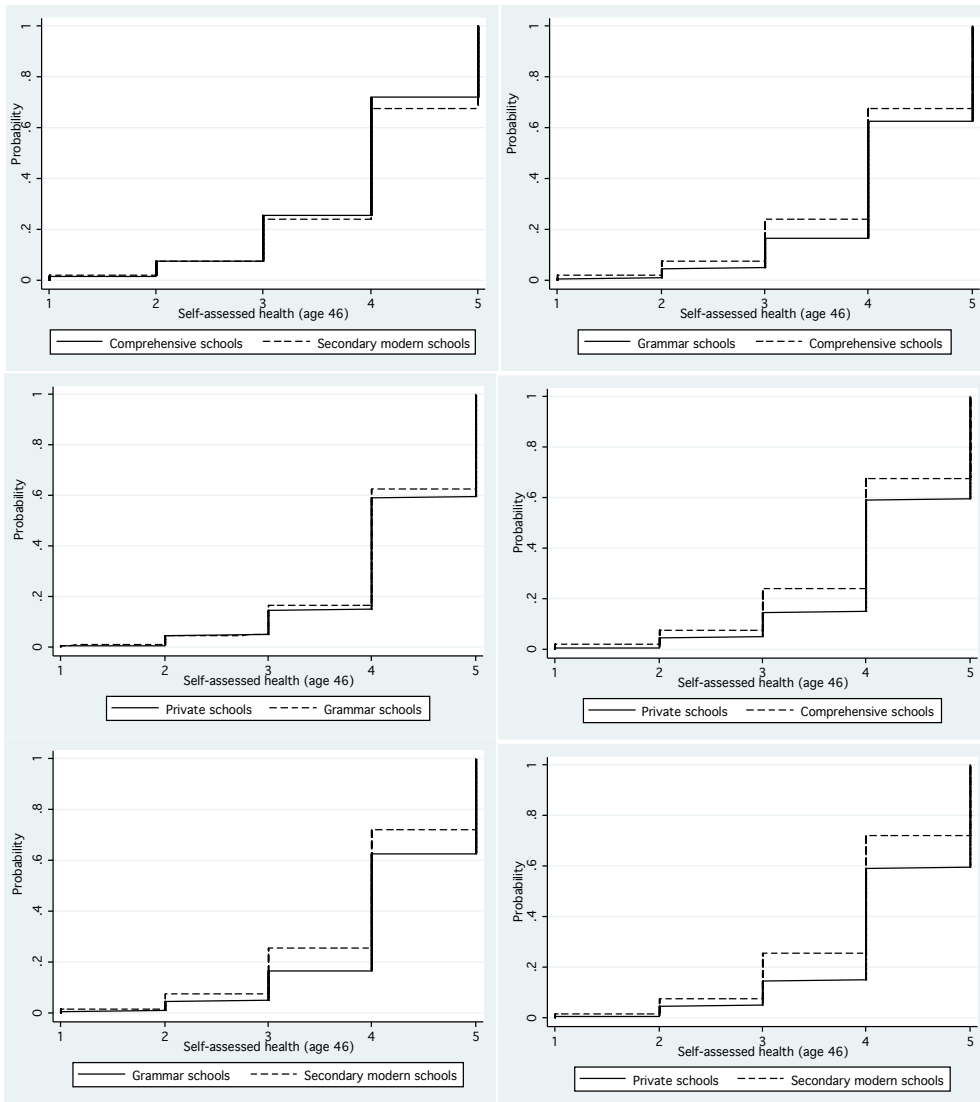
Figure 6: Stochastic dominance: empirical distributions of mental illness (age 46) by type of secondary school
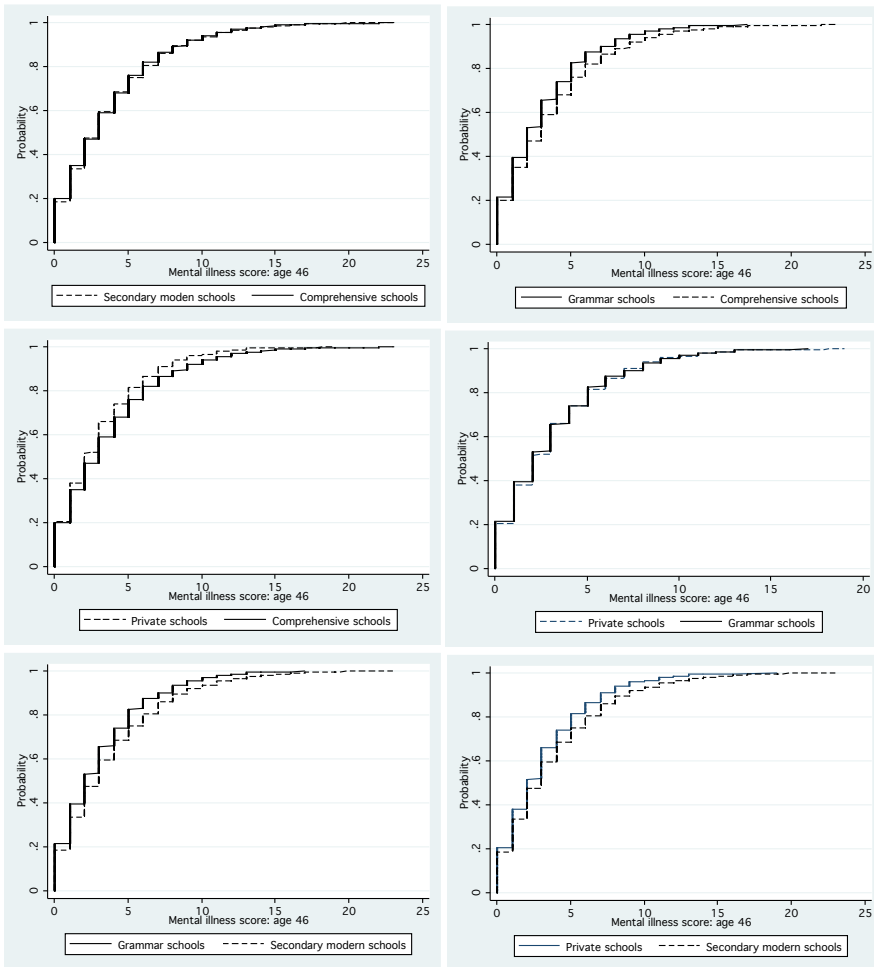
Table 1: NCDS cohort-members by type of primary school

	obs	unhappy at school	Pupil-teacher ratio
State primary schools	12,309	803 (6.52%)	35.07
Private primary schools	449	22 (4.9%)	21.9

Table 2: Secondary school characteristics

	Grammar	Sec Modern	Comprehensive	Private
% single sex	68.2	25.7	13.1	78.7
% with ability streams	16.6	42.8	40.6	23.7
% former grammar			24.7	
% former sec modern			18.3	

Table 3: Estimation sample vs full sample

VARIABLES	Obs	Full sample Mean	Std. Dev.	Min	Max	Estimation sample Mean	Std. Dev.	Min	Max
Self-assessed health (age 46)	5575	3.967	0.954	1.000	5.000	4.088	0.852	1.000	5.000
Northwest	12846	0.136	0.342	0.000	1.000	0.118	0.323	0.000	1.000
E. W. Riding	12846	0.083	0.276	0.000	1.000	0.089	0.284	0.000	1.000
Northmidlands	12846	0.075	0.264	0.000	1.000	0.092	0.290	0.000	1.000
Midlands	12846	0.098	0.297	0.000	1.000	0.102	0.302	0.000	1.000
East	12846	0.071	0.257	0.000	1.000	0.105	0.307	0.000	1.000
Southeast	12846	0.199	0.399	0.000	1.000	0.176	0.381	0.000	1.000
Southwest	12846	0.054	0.226	0.000	1.000	0.083	0.277	0.000	1.000
Wales	12846	0.054	0.225	0.000	1.000	0.072	0.259	0.000	1.000
% of council tenants in enumeration district	8337	33.111	38.399	0.000	100.000	26.208	34.124	0.000	100.000
Father's S.C.: high	11153	0.273	0.446	0.000	1.000	0.324	0.468	0.000	1.000
Father's S.C.: middle	11153	0.510	0.500	0.000	1.000	0.511	0.500	0.000	1.000
Father's years of schooling	6204	9.950	1.659	7.000	16.000	10.023	1.679	7.000	16.000
Mother's years of schooling	6449	9.950	1.410	7.000	16.000	10.023	1.410	7.000	16.000
Financial hardship (age 7)	8277	0.081	0.273	0.000	1.000	0.048	0.215	0.000	1.000
Morbidity index(age 7)	9389	1.772	1.412	0.000	10.000	1.731	1.383	0.000	8.000
Nb. Hospitalisations(age 7)	10124	0.355	0.624	0.000	5.000	0.370	0.624	0.000	5.000
Diabetes in close relatives(age 7)	10124	0.020	0.141	0.000	1.000	0.027	0.161	0.000	1.000
Epilepsy(age 7)	10124	0.071	0.257	0.000	1.000	0.070	0.256	0.000	1.000
Chronic hart illness: close relatives (age 7)	10124	0.023	0.148	0.000	1.000	0.030	0.170	0.000	1.000
Mother: Cigarettes per day(age 16)	6310	5.865	7.392	0.000	30.000	4.975	6.926	0.000	30.000
Obese at age 16	12846	0.027	0.163	0.000	1.000	0.048	0.215	0.000	1.000
Cognitive ability score (age 11)	9008	-0.033	1.573	-3.891	4.020	0.490	1.457	-3.299	3.926
# teachers / # pupils at school, age 16	8688	0.056	0.009	0.012	0.174	0.056	0.014	0.020	0.618
# expelled pupils / # pupils at school, age 16	8444	0.000	0.001	0.000	0.044	0.000	0.001	0.000	0.018
Social adjustment test (age11)	9034	8.609	8.951	0.000	70.000	6.259	7.564	0.000	56.000
1+ passes at CSE or O level, grades 4 or 5 only	9168	0.093	0.290	0.000	1.000	0.065	0.246	0.000	1.000
1+ passes at CSE, grades 2 or 3	9168	0.098	0.298	0.000	1.000	0.079	0.270	0.000	1.000
5+ passes at CSE, grades 2 to 5	9168	0.134	0.341	0.000	1.000	0.144	0.351	0.000	1.000
1-4 passes at GCE O level or CSE grade 1	9168	0.242	0.428	0.000	1.000	0.318	0.466	0.000	1.000
5 or 6 passesGCE O level or CSE 1	9168	0.047	0.212	0.000	1.000	0.065	0.246	0.000	1.000
7+ passes at GCE O level grades A-C, or CSE grade 1	9168	0.033	0.177	0.000	1.000	0.047	0.212	0.000	1.000
1 pass at A level, grades A-E	9168	0.027	0.163	0.000	1.000	0.036	0.188	0.000	1.000
2 passes at A levels, up to 8pts	9168	0.034	0.180	0.000	1.000	0.052	0.222	0.000	1.000
3+ passes at A levels, up to 8pts	9168	0.025	0.157	0.000	1.000	0.034	0.181	0.000	1.000
2 passes at A levels and 9+ pts	9168	0.002	0.045	0.000	1.000	0.002	0.046	0.000	1.000
3+ passes at A levels and 9+pts	9168	0.039	0.194	0.000	1.000	0.045	0.207	0.000	1.000
University degree or eq.	5579	0.190	0.392	0.000	1.000	0.199	0.399	0.000	1.000
# cigarettes per day (age 33)	6943	5.574	9.506	0.000	80.000	3.993	8.164	0.000	60.000
Units of alcohol per week(age 33)	7005	16.809	24.076	0.000	294.930	16.933	21.339	0.000	234.220
Own social class: high (age 46)	5603	0.428	0.495	0.000	1.000	0.454	0.498	0.000	1.000
Own social class: middle (age 46)	5603	0.418	0.493	0.000	1.000	0.396	0.489	0.000	1.000
Comprehensive School	8946	0.566	0.496	0.000	1.000	0.557	0.497	0.000	1.000
Secondary Modern	8946	0.254	0.435	0.000	1.000	0.229	0.420	0.000	1.000
Private School	8946	0.068	0.251	0.000	1.000	0.052	0.222	0.000	1.000

Table 4: Quality of primary schooling, health and health related behaviours

	Model1	Model2	Model3	Model4	Model5
Dep. Variable: SAH, age 46					
Private school, 1969	-0.045	-0.047	-0.055	-0.045	-0.041
Ratio: #pupils / # teachers, 1969	0.001	0.000	0.001	0.001	0.001
Unhappy at school, 1965	-0.068**	-0.050*	-0.064**	-0.057*	-0.051
Dep. Variable: Long standing illness / disability, age 46					
Private school, 1969	0.026	0.027	0.033	0.017	0.012
Ratio: #pupils / # teachers, 1969	-0.002	-0.002	-0.003*	-0.002	-0.001
Unhappy at school, 1965	0.073**	0.083**	0.061	0.029	0.044
Dep. Variable: Mental illness, age 46					
Private school, 1969	0.427	0.427	0.562	0.618	0.634
Ratio: #pupils / # teachers, 1969	-0.022**	-0.022**	-0.019**	-0.018*	-0.019*
Unhappy at school, 1965	0.788***	0.788***	0.871***	0.761**	0.374
Dep. Variable: Smoker, age 42					
Private school, 1969	-0.039	-0.038	--	-0.032	-0.020
Ratio: #pupils / # teachers, 1969	-0.001	-0.000	--	0.000	0.000
Unhappy at school, 1965	0.016	-0.002	--	-0.003	-0.012
Dep. Variable: Units of alcohol / week, age 42					
Private school, 1969	-0.325	0.233	--	1.413	1.666
Ratio: #pupils / # teachers, 1969	0.010	0.001	--	-0.016	-0.019
Unhappy at school, 1965	-2.545*	-2.080	--	-2.734*	-1.162
Dep. Variable: Fried food / week, age 42					
Private school, 1969	0.008	0.004	--	-0.001	-0.002
Ratio: #pupils / # teachers, 1969	-0.000	-0.000	--	0.000	-0.000
Unhappy at school, 1965	-0.003	-0.004	--	-0.004	-0.002
Dep. Variable: Teenage pregnancy					
Private school, 1969	-0.033	-0.018	--	-0.018	-0.011
Ratio: #pupils / # teachers, 1969	-0.002*	-0.001	--	-0.001	-0.000
Unhappy at school, 1965	0.012	0.003	--	-0.001	0.000
Dep. Variable: Smoking during pregnancy					
Private school predicts failure in 100% of cases				--	--
Ratio: #pupils / # teachers, 1969	-0.002	-0.001	--	-0.002	-0.003
Unhappy at school, 1965	-0.025	-0.052	--	-0.053	-0.071

*** p<0.01, ** p<0.05, * p<0.1

Table 5: Quality of secondary schooling, health and health related behaviours

	Model 1	Model 2	Model 3	Model 4	Model 5
Dep. Variable: SAH, age 46					
Comprehensive School	-0.039	-0.014	-0.016	-0.021	-0.029
Secondary Modern	-0.060**	-0.013	-0.013	-0.004	-0.025
Public School	-0.018	-0.006	-0.011	-0.025	-0.034
Comprehensive formed from sec. modern	0.008	0.019	0.031	0.049	0.046
Comprehensive formed from grammar school	0.008	0.009	0.018	0.022	0.023
singlesex	0.000	-0.006	-0.002	0.005	0.005
Boarder NCDS3	-0.057	0.001	0.046	0.021	-0.052
school class allocation	-0.015	-0.015	-0.022	-0.027	-0.022
# pupils at school / # teachers, age 16	-0.001	-0.002	-0.002	-0.002	-0.000
# expelled pupils / # pupils at school, age 16	-15.279***	-14.192***	-16.616***	-20.020***	-14.747**
Dep. Variable: Long standing illnesss / disability, age 46					
Comprehensive School	0.085***	0.079**	0.108***	0.108***	0.111***
Secondary Modern	0.083**	0.057	0.072*	0.071*	0.078*
Public School	0.031	0.032	0.042	0.059	0.087
Comprehensive formed from sec. modern	-0.017	-0.016	-0.025	-0.037	-0.032
Comprehensive formed from grammar school	-0.039	-0.048	-0.066**	-0.051	-0.053
singlesex	0.022	0.025	0.037	0.029	0.036
Boarder NCDS3	-0.046	-0.033	-0.069	-0.010	-0.025
school class allocation	0.006	0.001	0.003	0.015	0.004
# pupils at school / # teachers, age 16	-0.001	0.001	0.000	-0.001	-0.003
# expelled pupils / # pupils at school, age 16	11.364	12.334	16.478	17.956	11.922
Dep. Variable: Mental illness, age 46					
Comprehensive School	0.346*	0.052	0.058	0.137	0.211
Secondary Modern	0.293	-0.241	-0.293	-0.163	-0.225
Public School	0.729**	0.858**	0.918***	1.161***	0.993***
Comprehensive formed from sec. modern	-0.221	-0.339*	-0.470**	-0.419*	-0.387*
Comprehensive formed from grammar school	-0.225	-0.335	-0.494**	-0.467*	-0.509**
singlesex	0.034	-0.019	-0.041	0.040	0.047
Boarder NCDS3	0.123	-0.229	-0.198	0.300	1.435
school class allocation	-0.062	-0.074	-0.035	0.098	0.198
# pupils at school / # teachers, age 16	0.025	0.024	0.011	0.028	0.029
# expelled pupils / # pupils at school, age 16	54.209	80.642	83.476	62.277	34.156
Dep. Variable: Smoker, age 42					
Comprehensive School	0.040	0.014	---	-0.012	-0.037
Secondary Modern	0.068**	0.013	---	-0.030	-0.050
Public School	-0.011	-0.010	---	-0.052	-0.055
Comprehensive formed from sec. modern	0.040*	0.027	---	0.010	0.006
Comprehensive formed from grammar school	0.021	0.028	---	0.022	0.031
singlesex	-0.010	-0.009	---	-0.023	-0.026
Boarder NCDS3	0.091	0.032	---	0.107	0.190
school class allocation	0.010	0.011	---	0.014	0.004
# pupils at school / # teachers, age 16	0.003	0.002	---	0.001	0.002
# expelled pupils / # pupils at school, age 16	13.381**	4.700	---	3.997	4.522

	Model 1	Model 2	Model 3	Model 4	Model 5
Dep. Variable: Units of alcohol / week, age 42					
Comprehensive School	-0.811	0.169	---	0.095	-0.351
Secondary Modern	-2.339*	-0.770	---	-0.878	-1.316
Public School	0.023	1.480	---	1.570	1.372
Comprehensive formed from sec. modern	-1.083	-0.159	---	0.490	-0.218
Comprehensive formed from grammar school	-0.452	-0.357	---	-1.054	-1.445
singlesex	-1.325	-1.194	---	-1.281	-1.548
Boarder NCDS3	4.834	4.539	---	0.456	1.151
school class allocation	-0.004	0.145	---	-0.449	-0.212
# pupils at school / # teachers, age 16	-0.020	-0.018	---	0.036	0.109
# expelled pupils / # pupils at school, age 16	447.360	515.972	---	225.261	536.518
Dep. Variable: Fried food / week, age 42					
Comprehensive School	0.007*	0.002	---	0.005	0.003
Secondary Modern	0.001	-0.004	---	0.002	0.001
Public School	0.009	0.005	---	0.001	0.002
Comprehensive formed from sec. modern	0.010**	0.010**	---	0.014***	0.011**
Comprehensive formed from grammar school	-0.002	-0.002	---	0.001	-0.001
singlesex	0.002	0.001	---	0.001	0.000
Boarder NCDS3	0.009	0.011	---	0.023	0.042
school class allocation	-0.000	-0.001	---	-0.001	-0.001
# pupils at school / # teachers, age 16	0.000	0.000	---	0.000	0.000
# expelled pupils / # pupils at school, age 16	1.043	1.513	---	1.224	1.784
Dep. Variable: Teenage pregnancy					
Comprehensive School	0.079***	0.040*	---	0.024	-0.001
Secondary Modern	0.119***	0.054*	---	0.020	-0.018
Public School	0.121**	0.084	---	0.146	0.084
Comprehensive formed from sec. modern	0.012	0.016	---	0.034	0.029
Comprehensive formed from grammar school	0.003	0.005	---	0.017	0.014
singlesex	0.011	0.018	---	0.028	0.013
Boarder: dropped due to perfect collinearity			---	---	---
school class allocation	-0.004	-0.005	---	-0.007	-0.012
# pupils at school / # teachers, age 16	-0.003	-0.003	---	-0.001	0.000
# expelled pupils / # pupils at school, age 16	-6.387	-3.915	---	-11.149	-4.585
Dep. Variable: Smoking during pregnancy					
Comprehensive School	0.051	0.007	---	0.005	0.007
Secondary Modern	0.095	0.006	---	0.004	-0.042
Public School	-0.071	-0.087	---	-0.044	-0.034
Comprehensive formed from sec. modern	-0.071*	-0.079*	---	-0.102***	-0.078***
Comprehensive formed from grammar school	0.070	0.073	---	0.089	0.063
singlesex	0.021	0.011	---	0.021	0.077
Boarder: dropped due to perfect collinearity			---	---	---
school class allocation	-0.007	0.006	---	0.059	0.027
# pupils at school / # teachers, age 16	0.012	0.013	---	0.019*	0.033***
# expelled pupils / # pupils at school, age 16	33.131**	29.502*	---	17.366	18.244

*** p<0.01, ** p<0.05, * p<0.1

Table 6: Stochastic dominance tests for inequality of opportunity in health

SAH (age 46)	Comprehensive school	Secondary modern school	Grammar school	Private school
Comprehensive school				
Secondary modern school				
Grammar school	Gr. *FSD* Comp.	Gr. *FSD* Sc. Mod.		
Private school	Priv. *FSD* Comp.	Priv. *FSD* Sc. Mod.		

Chronic illness / disability (age 46)	Comprehensive school	Secondary modern school	Grammar school	Private school
Comprehensive school			Comp. *FSD* Gr.	
Secondary modern school			Sc. Mod. *FSD* Gr.	Sc. Mod. *FSD* Priv.
Grammar school				
Private school				

Mental illness (age 42)	Comprehensive school	Secondary modern school	Grammar school	Private school
Comprehensive school			Comp. *FSD* Gr.	
Secondary modern school			Sc. Mod. *FSD* Gr.	
Grammar school				
Private school				

Smoking (age 42)	Comprehensive school	Secondary modern school	Grammar school	Private school
Comprehensive school			Comp. *FSD* Gr.	Comp. *FSD* Priv.
Secondary modern school			Sc. Mod. *FSD* Gr.	Sc. Mod. *FSD* Priv.
Grammar school				
Private school				

Notes: Kolmogorov-Smirnov test results at 1 per cent significance level