Measuring educational inequality of opportunity: pupil's effort matters

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ABSTRACT

The distinction between effort and other factors, such as family background, matters for correcting policies and normative reasons when we appeal to inequality of opportunity. We take advantage of a purposefully designed survey on secondary schools in rural Bangladesh to offer a comprehensive view of the importance of overall effort when measuring inequalities of opportunity in education. The analysis comprises decomposition exercises of the predicted variance of student performance in mathematics and English by source (effort, circumstances, etc.) and subgroup (within- and between-schools) based on parametric estimates of educational production functions. Pupils' effort, preferences, and talents contribute between 31% and 40% of the total predicted variances in performance scores. The contribution of overall effort falls by 10% when the correlation between effort and circumstances is taken into account. These findings are robust to the choice of estimation strategy (i.e. combined within- and between-schools variation models versus multilevel random-effect models). All in all, these results advocate that social determinism in education can be mitigated by individual effort at school.

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1. Introduction

No one can dispute two general ideas. First, primary and secondary education are crucial for many achievements in different dimensions of well-being such as income attainment, health, marriage, leisure, social networks and so on. Second, broadly speaking, a minimal requirement of equal opportunity policy is leveling the playing field for the most deprived. Putting together these ideas, they call for an education policy that tries to equalize competences in numeracy and literacy skills among all the youth. Now, even if we agree on that as a social goal, it is much more difficult to understand how it can be achieved in a practical manner.

A first step is to understand what the key factors that determine the educational outcome are. Our research question is whether student effort in school matters for inequality of educational achievement and how. The importance of effort as a direct determinant of student performance is well-acknowledged by learning theorists (Bloom, 1974). Theoretical models of educational produc-

tion process also recognize effort and learning ability as critical student-specific inputs (e.g. see Bishop & Wossmann, 2004). Research also confirms a positive relationship between inequality of effort and economic growth (Marrero & Rodriguez, 2013). Emerging evidence indicates that policy measures (e.g. provision of free school meals) can positively influence learning outcomes in developing countries by increasing classroom efforts of students (Afridi & Barooah, 2019). Yet, the existing literature on the nature and causes of inequality of educational opportunities does not measure the contribution of effort (Breen & Jonsson, 2005; Singh, Singh, Pallikadavath, & Ram, 2014; Golley & Kong, 2018; Hannum, Ishida, Park, & Tam, 2019; Idzalika & Lo Bue, 2020).

Reasons for the omission of effort and ability in empirical research primarily relate to measurement difficulty and data availability. Another reason relates to differences across disciplines regarding the role of efforts in shaping educational success. Sociologists, for instance, argue that effort alongside ability offers a major mechanism through which family background advantage is transformed into educational achievement (see Katsillis & Rubinson, 1990). This is an important gap in the literature because the types of public intervention depend on the specific channel through which inequalities in education achievements are sustained. General economic and social policies against inequalities

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matter to reduce inequality due to family and social background. If the between-schools disparity is large for the same composition of pupils according to socioeconomic status, then a more focused educational policy must be endeavoured. If effort matters a lot, then correcting policies directed to the parents and academic support might be the right approach. The distinction between effort and other factors may also matter for normative reasons when we appeal to the philosophy of equality of opportunity.

The last few decades have witnessed the remarkable development of new quantitative methods for the measurement of inequality of opportunity in different social settings, including income attainment, health status and education (see Ferreira & Peragine, 2016; Roemer & Trannoy, 2015; Ramos & Van de Gaer, 2016 for reviews). All versions around the notion of inequality of opportunity distinguish between legitimate and illegitimate sources of inequality. The former are due to factors for which the individual can be held responsible, whereas the latter stem from factors beyond the individual's control. In Roemer's terminology (Roemer, 1998), these are efforts and circumstances, respectively. The typical ethical prescription is that inequalities due to circumstances should be compensated for (principle of compensation); whereas those due to efforts, hence deemed legitimate, should be respected when designing the redistribution policies (principle of liberal reward; Fleurbaey (2008)).

These moral judgments do not need to be endorsed in the field of education, insomuch as, according to Arneson (1990), the philosophy of equality of opportunity is only meaningful beyond an 'age of consent' defined as the age from which people should be held responsible for their effort. The concept of age of consent is particularly relevant in the field of education as primary and secondary education mainly happens in childhood and teenage years (Roemer & Trannoy, 2015). Looking into income attainment, Hufe, Peichl, Roemer, and Ungerer (2017) tested various cutoff ages for the age of consent and showed a significant increase of the magnitude of inequality of opportunity when the vector of circumstances includes childhood and teenage school outcomes, especially at age 16.

We do not bring new ethical arguments here; needless to say that the matter is of minor importance if effort plays a secondary role in determining educational outcomes. There is likely to be a diversity of judgments affecting all aspects of measuring the role of effort and we should recognise this explicitly in the procedures we adopt. We bring new evidence about the importance of student effort in determining learning outcomes. We do so by accounting for competing views in two ways: (i) pondering the right notion of effort with respect to circumstances; and (ii) exploring the role of student preferences and talent, two important dimensions somewhat related to effort, and often, but not always, viewed as legitimate sources of inequality according to the philosophy of responsibility egalitarianism.

First, some authors claim that only the effort purged of the impact of circumstances should be respected. The original debate about the correlation between efforts and circumstances between Roemer (1998) and Barry (2005) was about the case of Asian students who 'generally work hard in school and thereby do well because parents press them to do so' (see e.g. Hsin & Xie, 2014). According to Roemer (1998), the 'familial pressure is clearly an aspect of their environment outside their control' and so an equal-opportunity policy must respect the individual effort disembodied from the circumstances. This is reminiscent of the stance of sociologists recalled above. Conversely, Barry (2005) argued that students are not less 'admirable and less deserving than it would have been absent such pressure' and so the full effort of the Asian student should be rewarded and the lack of familial pressure of other students compensated.

Second, there are two competing views on whether preferences and talent may be deemed legitimate sources of inequality in the philosophy of responsibility.[1] Some philosophers following Dworkin (1981a, 1981b) consider that preferences should be fully respected so that individuals are considered responsible for their preferences (Fleurbaey, 2008), while others like Cohen (1989) see individuals as only responsible for what they can control. As for talent, Vallentyne (1997) argues that a self-ownership argument may entitle agents for the full benefits of their natural personal endowments while Roemer et al., 2003 put talent on the effort side because talent and effort are quite complementary in many cases (Trannoy, 2018). In the context of education, one would agree that understanding well mathematics (talent) is generally correlated with enjoying maths class (preferences) and doing maths exercises (effort). As emphasized by Cunha and Heckman (2007), skills beget skills and there is a dynamic complementarity between skills attained at one stage and investment (effort) at subsequent stages. Therefore, given the feedback effects, talent and preferences should best be viewed as additional dimensions of the broader notion of overall student effort.

We propose an empirical approach sufficiently flexible to encompass competing views on how the correlation between circumstances and each component of overall effort including school effort, preferences, and talent matter when measuring the magnitude of inequality of opportunity in school performance. This is achieved using a method building on Jusot, Tubeuf, and Trannoy (2013) to decompose the variance of student test scores, which is our index of absolute educational inequality.

More specifically, we apply our empirical approach to the implementation of two antagonistic views regarding the role of the correlation between circumstances and effort. Firstly, our baseline model follows Barry (2005), which entails incorporating the observed effort variables (including preferences and talent) into a model of school performance outcomes without any prior modelling of effort. For a given dataset and choice of variables, this model yields the maximum possible contribution of effort variables toward inequality in school performance; thereby minimising the measure of inequality of opportunity stemming from the contribution of variables deemed beyond pupil's control. Secondly, we investigate whether the correlation between effort and circumstances can mitigate the role of effort found in the baseline model. The alternative model, dubbed the variant, requires a prior modelling stage where effort variables are purged out of their association with circumstances. Then, student performance is estimated using the estimated residuals of this modelling phase, which represent the orthogonalized effort, instead of the raw observed effort variables. Hence, the model reflects the view of Roemer (1998) where only the part of effort not attributable to circumstances is allowed to contribute toward inequality in school performance. In consequence, the contribution of effort variables is reduced, while that of circumstances is inflated. Lastly, we make a further contribution to the existing literature by extending the method of Jusot et al. (2013) to permit the within and between-schools contributions to educational inequality using a hierarchical model.

We use data from a unique survey undertaken among students attending secular schools and registered-aided Islamic schools[2] in Bangladesh. Detailed data on family and social background characteristics as well as school and teachers for more than 300 schools are available. Besides, the dataset provides an accurate picture of the degree of dispersion in several outcomes of interest like mathematics and English test scores as well as pupils' efforts. The

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[1] For an overview of different definitions of legitimate and illegitimate inequality in education, following the inequality-of-opportunity paradigm, see Brunori and Peragine (2012).

[2] What we describe as state schools in QSSMEB data includes both secular and registered-aided Islamic schools. (e.g. Asadullah (2016))

dataset allows us to adopt an encompassing view of overall effort, which includes dimensions of preferences for leisure and eagerness to study, as well as social skills at class, and talent for mathematics and English.

We find that the contribution of overall effort comes first in explaining within-school variations in test scores, whereas the contribution of circumstances (i.e. family and parental background) is crucial for between-schools variations. Many may argue that in the context of developing countries the main issue is not individual inputs such as student effort, but poor overall school quality. However, it is meaningful to study effort in a context where the overall learning level is low and our analysis demonstrates the importance of effort on student performance. For instance, excluding religion and demographic indicators in the case of mathematics, the share of the contribution of effort in within-school variations is around three times more important than the contribution of family background (baseline model). This ratio is still around 2:1 in the variant model (i.e. when we only consider efforts 'purged' of the effect of circumstances on them). We have the same pattern and the same order of magnitude in English achievements. The main difference between mathematics and English is that demographics are of primary importance in mathematics while playing only a minor role in English. As the numbers suggest, we find that the normative position on how to treat the correlation between circumstances and effort does not makes an important difference in rural education in Bangladesh.

The picture is the opposite in explaining between-schools inequality. In maths, the respective contribution of circumstances (vis-à-vis effort) is 1.2 times more important in the baseline model, and the ratio rises to 1.4 when we switch to the variant model. The numbers are a little bit higher for English (1.8 and 1.9 in the two viewpoints, respectively). The bottom line is that the variation in average school results is strongly associated with differences in pupils' family background and only moderately with variation in average effort at the school level. Demographics and religion play almost no role in English, whereas they are important in mathematics. School traits are not very important in mathematics while they are in English; the latter possibly related to English not being the main language of instruction and English teachers needing specific resources (computer, training, etc).

The degree of legitimate inequality due to student effort is sizeable, but significantly smaller than the degree of illegitimate inequality, and it is slightly larger for English test scores (40% to 34%) than it is for mathematics test scores (35% to 31%). The remaining sources of variation are clearly circumstances beyond pupils' control, whether family background or school characteristics, whose combined share is significantly higher (49%-63%); and demographics combined with religion, which only matters for maths (13%-16%, versus 3%-4% in English). This result underlines that in the case of rural Bangladesh effort accounts for about one third of total explained inequality and so cannot be omitted. These results do not depend much on the choice between a fixed- and a random-effect estimation strategy; they are also robust to purging the correlation between effort and circumstances as advocated by Roemer (1998). The contribution of effort does not decrease by more than 5 percentage points in mostly all cases.

The rest of the paper proceeds as follows. Section 2 provides a summary of the previous literature. Section 3 explains the rural Bangladesh context and describes key features of the dataset and the chosen performance outcomes, effort indicators, and circumstances. Section 4 describes our new measurement method for the baseline model. Section 5 presents our results. In the following section, we amend the method to accommodate for a possible correlation between effort and circumstances and we comment on the associated results. Then the paper concludes with some final remarks.

2. Background and literature review

This paper is at the cross-road of two streams of literature, the first one that focuses on introducing effort in the production function of education, the second one which attempts to measure inequality of opportunity in education. We briefly summarise the relevant literature in this section and clarify how we build on the existing debates relating to concepts, methods and measurements.

In the literature on the educational production function, some studies show effort playing only a minor role in determining learning outcomes (Feinstein, 2003; Cunha & Heckman, 2007) and being strongly impacted by family and social background. Students' school performance is highly correlated with parental income, education, cognitive abilities, and parents' own effort as measured by their aspirations for, communication, and participation in their children's school matters (Haveman & Wolfe, 1995; Ermisch & Francesconi, 2001; De Fraja & Oliveira, 2010). However, Cunha and Heckman (2007) found that parents' inputs matter more at early ages, especially for cognitive skills while they impact on non-cognitive skills at later ages. Similarly, Del Boca, Montfardini, and Nicoletti (2017) recently showed that adolescents increasingly become actors of their achievements with age: mother's time investment appears to matter more during childhood than during adolescence and test scores in adolescence are more affected by the child's own time investment than the mother's. Therefore, whilst pupils' effort at school is significantly constrained by circumstances, it also appears to matter independently from circumstances on school performance.

Most previous empirical investigations of education inequality of opportunity faced limited or no availability of detailed data on efforts, which led to the adoption of a so-called *ex-ante* approach (Fleurbaey & Peragine, 2013). In most empirical operationalisations, the *ex-ante* approach consists of computing the degree of inequality across the outcome means of mutually exclusive social groups known as types (Roemer, 1998). These types are defined by combining and intersecting circumstances deemed beyond people's control.[3] The means for each type are calculated either with non-parametric or parametric standard methods. Thus, the *ex-ante* approach enables the quantification of inequality of opportunity in the absence of efforts data.

For instance, Gamboa and Waltenberg (2012) follow a non-parametric approach (Checchi & Peragine, 2010) meaning that they replace the score of each student by the average score of his type. Ferreira and Gignoux (2014) regress the achievement on circumstances and then compute the smoothed distribution, which is obtained by using the predicted values of outcomes based on circumstances. The ratio of the between-group inequality to total inequality then measures the inequality of opportunity in education. It is the procedure used for instance by Ferreira and Gignoux (2014) who use the variance as inequality index which is the only decomposable inequality index invariant to an affine transformation of the outcome variable (Zheng, 2007) while Gamboa and Waltenberg (2012) use both the mean logarithmic deviation and the square of coefficient of variation. The smoothed distribution represents only one way of obtaining a counterfactual distribution by computing what would be the inequality if only circumstances matter empirically. To this direct approach, one can oppose an indirect approach where the counterfactual distribution is computed, absent of any disparity of circumstances (see for an example Salehi-Isfahani & Hassine (2014)). These three papers apply the inequality of opportunity methodology to international data on educational achievement. While the extent of educational

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[3] For instance, in a hypothetical society with only two such circumstances, e.g. binary gender and two skin colours (e.g. "black" and "white"), there would be four types: "black men", "black women", "white women", "white men".

inequality of opportunity varies significantly across countries, Asian countries as a whole do not exhibit particularly high levels. However none of the quoted studies explicitly introduced effort variables in the regression explaining educational achievement or educational inequality.

In this paper, we stick to the variance as an index of educational inequality as in Ferreira and Gignoux (2014). With this measure, the direct and indirect way to compute counterfactuals lead to the same level of educational inequality. Our main contribution is to account for effort variables in the regression analysis and to compute the correlation between effort and circumstances. We also analyse the within and between-schools contributions to educational inequality by resorting to a hierarchical model. In that way, our methodology can be deemed an extension of that of Jusot et al. (2013), and as such, has not been implemented before.

Lastly, our review of the broader social sciences literature confirms that effort is a multidimensional concept. According to Bozick and Depmsey (2010), who review studies which analyse student efforts in the educational and social science research publications, the measurement of effort does not have a well-established base on which to draw. While several social sciences studies empirically model student effort as inputs in educational production, the measures of effort vary widely. Effort at school has basically been measured by hours per week doing homework (Brookhart, 1998), time spent per day on school-related homework (Katsillis & Rubinson, 1990), and study time either from the students' perspective (De Fraja & Oliveira, 2010; Kuehn & Landeras, 2014) or the teachers' (Eren & Henderson, 2011). Other effort measures include classroom attendance (Aker & Ksoll, 2012) and a composite measure of the broader construct of effort for all schoolwork (Brookhart, 1998)[4] or even a combination of study and effort together along with an identification variable in the statistical sense. For instance, Stinebrickner and Stinebrickner (2008) focused on variables such as class attendance, sleeping, drinking, study efficiency, paid employment in combination with the availability of a roommate's computer game. In addition to these self-reported indices of student effort, the literature also employs experimental measures such as solving maze puzzles (Afridi & Barooah, 2019) and indirect measures such as teacher's evaluations and expectations of student effort (Alexander & Entwisle, 1987; Roscigno & Ainsworth-Darnell, 1999).

There are also differences in the way effort is conceptualized. While most studies employ an absolute measure, Peterson and Woessmann (2007) suggest that "…the best measure of an individual's effort is effort relative to effort of others in his or her type, as captured by rank or quantile on the effort distribution of type".

In addition, there is broad agreement among scholars to distinguish between effort and closely related concepts such as talents and ability in understanding the differences in student performance (Nicholls, 1978; Schunk, 1983; Dweck, 2002; Peterson & Woessmann, 2007; Spruyt, 2015). However, there is no consensus on whether they are complements or substitutes (Muenks & Miele, 2017). Chadi and de Pinto (2019) report a negative link between effort and ability while Peterson and Woessmann (2007) treat ability and talents as complements. In public opinion surveys, respondents attribute educational success to effort when compared to educational failure. However, "talent" was not considered very important as an explanation for educational outcomes (Spruyt, 2015).

In view of the literature discussed in this section, our analysis in this paper adopts a multi-dimensional approach in conceptualizing and measuring effort in broad terms, by additionally accounting for pupils' preferences and talent. We consider this as another contribution of the study. We further elaborate on measurement issues related to student effort in school in Section 3.3.3 and Table A1.

3. Schooling in rural Bangladesh: context and data source

3.1. Context

The secondary education system in rural Bangladesh is characterized by two streams: secular schools operating alongside Islamic schools. Islamic schools enrolment is modest at the primary level (about 14%) but more substantial at the secondary level, 30% (Asadullah, 2016). While Islamic schools are thought to be run by motivated religious personnel and credited to offer a cheaper alternative to poorer people, they are also feared for the potential nurturing of militancy, but fundamentally criticised for offering education of poorer quality[5], thereby potentially perpetuating a poverty cycle.

However, the quality of non-religious secondary schools is also poor in rural areas. Evidence shows low levels of learning across school types and grades (Asadullah & Chaudhury, 2015; Asadullah, 2016). Many parents therefore invest in supplementary learning activities in after-school hours, either hiring house tutors or sending children to privately-run coaching centres. Evidence confirms that children with a private house tutor enjoy significantly more study time out of school compared to those without (Amin & Chandrasekhar, 2012). The demand for after-school private tutoring in English is particularly high (Mahmud & Bray, 2017). While private tutoring in coaching centres is not uncommon in rural Bangladesh, it is likely to be more observed in economically well-off households (Pallegedara & Mottaleb, 2018).

Lastly, in reality, there are two types of Islamic schools in rural Bangladesh. Starting in the early 1980s, the government offered financial incentives to Islamic schools in exchange for teaching the state curriculum and accepting female students. Most Islamic schools took up the offer and became recognised Islamic schools[6]. A minor unregulated sector called unrecognised Islamic schools remained. These unrecognised Islamic schools are not included in our analysis as they do not teach the same curriculum. According to the 2008 Quality of Secondary School Madrasah Education in Bangladesh Census, registered Islamic schools in rural Bangladesh have market shares of 13.8% and 22.1% in primary and secondary education, respectively. The corresponding enrollment shares for unrecognised Islamic schools are 5.4% (primary) and 3.6% (secondary) (Asadullah & Chakrabarti, 2015 Table 1).

3.2. Data source

The data come from a survey called "Quality of Secondary School Madrasah Education in Bangladesh" (QSSMEB) which was fielded in 2008 under the auspices of the World Bank in order to gauge the quality of education in recognised Islamic schools vis-à-vis secular schools. Detailed information about the sampling procedure, scope and range of information provided by the survey can

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[4] The composite index comprised response to the followings: "Ask the teacher or a friend for help as soon as I run into a problem at school"; "Give up when I don't understand a problem right away"; "Goof off in school"; "Put off studying as long as I can"; "Discuss serious things with my friends rather than fool around"; "Try hard to do my best in school"; "Do the things I want to do first and leave my studying and other work to the last minute"; and "Try harder if I get b".

[5] Quality is defined in terms of low level of language and numeracy skills among students. Islamic schools allocate fewer hours to English language and mathematics education and teachers also lack formal training in such subjects.

[6] Noticeably the initiative helped reduce the gender gap in female education (Asadullah & Chaudhury, 2009).

Table 1
Decomposition of educational inequality by sources, between and within-schools variations.

	OLS		Multilevel Random effect		Multilevel Within-schools		Combined Between & Within	
English	**Barry**	**Roemer**	**Barry**	**Roemer**	**Barry**	**Roemer**	**Barry**	**Roemer**
Within-schools	**52.66**	**52.47**	**50.20**	**50.11**	**39.16**	**39.13**	**27.34**	**27.72**
Pupil's effort (%)	22.16	19.05	22.25	19.00	17.70	15.17	12.99	11.95
Pupil's preferences (%)	6.55	6.09	5.90	5.43	4.89	4.56	2.75	2.39
Pupil's talent (%)	8.61	6.59	7.85	5.98	6.21	4.77	4.44	3.84
Social background (%)	9.89	12.58	7.31	9.75	5.14	7.25	3.90	5.27
Parental effort (%)	2.71	4.37	3.35	5.00	2.70	4.02	1.39	1.90
Age, gender, religion (%)	2.74	3.78	3.55	4.94	2.51	3.37	1.87	2.37
Between-schools	**47.34**	**47.53**	**49.80**	**49.89**	**60.84**	**60.87**	**72.66**	**73.21**
Pupil's effort (%)					6.48	7.00	13.94	15.25
Pupil's preferences (%)					1.20	1.30	2.91	1.86
Pupil's talent (%)					1.08	0.91	3.11	2.47
Social background (%)					19.56	19.57	23.17	24.43
Parental effort (%)					−2.73	−2.76	−0.73	−0.28
Age, gender, religion (%)					0.75	−0.08	2.03	1.54
Teacher behaviours (%)	14.99	15.07	19.84	19.87	12.45	12.61	9.69	10.58
School characteristics (%)	32.35	32.46	29.93	30.02	22.05	22.30	18.53	17.36
Mathematics	**Barry**	**Roemer**	**Barry**	**Roemer**	**Barry**	**Roemer**	**Barry**	**Roemer**
Within-schools	**64.23**	**64.02**	**56.66**	**56.51**	**36.23**	**36.48**	**27.09**	**27.46**
Pupil's effort (%)	13.56	12.26	15.28	13.29	10.16	9.01	7.57	6.68
Pupil's preferences (%)	9.57	8.53	3.77	3.20	2.74	2.38	1.51	1.28
Pupil's talent (%)	8.69	6.27	5.03	3.75	3.53	2.71	2.25	1.57
Social background (%)	10.23	13.41	3.65	5.36	2.52	3.81	1.67	2.40
Parental effort (%)	2.32	4.23	3.35	4.68	1.54	2.27	1.52	2.16
Age, gender, religion (%)	19.88	19.31	25.57	26.23	15.75	16.31	12.58	13.37
Between-schools	**35.77**	**35.98**	**43.34**	**43.49**	**63.77**	**63.52**	**72.91**	**72.54**
Pupil's effort (%)					12.94	13.34	17.94	17.84
Pupil's preferences (%)					1.89	2.01	2.89	2.78
Pupil's talent (%)					2.04	1.13	3.04	2.02
Social background (%)					21.77	23.00	23.08	24.89
Parental effort (%)					−0.78	−0.39	0.60	1.01
Age, gender, religion (%)					−1.31	−2.98	3.05	1.58
Teacher behaviours (%)	11.75	11.80	17.60	17.63	10.39	10.26	9.25	9.20
School characteristics (%)	24.01	24.19	25.74	25.86	16.83	17.15	13.05	13.22

Pupil's effort includes seven binary indicators, pupil's preferences is based on two binary indicators, and pupil's talent comprises three binary indicators. They are all described in Section 3.3.3. Social background includes four dummy variables of educational level completed for each parent, plus newspaper purchases, and a binary indicator of livestock ownership. Parental effort uses three binary indicators: having a house tutor, reading in coaching center, and receiving parental help. Teacher's behaviours includes indicators of frequency of meetings with parents, frequency of tests and pupil attendance. Finally, school characteristics include: a binary indicator for being a recognised Islamic school, a binary indicator of school admission policy, and binary indicators for possessions of computer and library.

be found in Asadullah and Chaudhury (2016) and in Asadullah (2016).[7] In this subsection we will focus on describing key measurement issues related to our educational inequality of opportunity assessment, in particular, identifying the outcome variables and different proxies of social background and effort in school.

3.3. Key variables and measurement issues

3.3.1. School-level data

The school-level samples by English and mathematics performance scores (standard deviations appear in parenthesis, where applicable) are presented in Table A3. The subject-specific samples differ little in terms of sample size and pupil-per-school distributions. About a quarter of schools in the sample are recognised Islamic schools.[8] Significant proportion of schools do not have either libraries (43%) or computer (48%). About two thirds of schools admit students from any primary school, instead of being selective.

A number of behaviours of the English and maths teachers are used in the performance score models. This includes teachers' reported average frequency of meeting with parents (every month, every 3 months, 6 months, or only if needed); whether almost all pupils attend the maths (respectively English) class; and whether teachers administer a minimum of four tests per year. Remarkably, a much higher proportion of English teachers administer at least four tests over the year (87% versus 27%) and similar proportions of English and maths teachers report near full attendance to their class (42%).

3.3.2. Educational outcomes

In each of the sampled schools, the surveyors administered a mathematics and an English language cognitive performance tests to 8th grade students. The mathematics performance test used 25 items of the Trends in Mathematics and Science Study (TIMSS)[9] and the English proficiency test with 20 items was based on the country's national curriculum (Asadullah, 2016).

While the inclusion of mathematics performance tests in the analysis is standard, the presence of English literacy may warrant a brief justification. While not a mother tongue in Bangladesh, Eng-

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[7] The survey should not be confused with the QSSMEB census cited above. Both were co-designed by one of this paper's co-authors and fielded in the same year.

[8] We also provide the descriptive statistics per school type in Tables A4 and A5 in Appendix.

[9] For further details see www.timss.com

lish literacy is a marker of social status. Moreover, English literacy is also deemed a key driver of labour market success. Hence, notwithstanding its scant day-to-day use in rural communities, English is certainly relevant and valued by students given its well-defined extrinsic value in the Bangladeshi labour market (for emerging developing-country evidence on this aspect see e.g Azam & Chin (2013, 2017, 2019)).

The distributions of scores for both tests by secular schools and recognised Islamic schools are presented in Figs. A1 and A2 in appendix. In line with the aforementioned evidence of poor quality of education in rural Bangladesh, most students failed to score above 50% of correct answers in each test. Also consistent with the cited evidence, the histograms for maths are not significantly different between secular schools and Islamic schools. By contrast, the distribution of English performance scores in secular schools features higher proportions of high-performing students and lower proportions of low-performing students vis-à-vis recognised Islamic schools' respective distribution.

3.3.3. Pupils' school efforts, preferences, and talents

As mentioned in Section 1, we define student efforts in school broadly by employing a combination of pupils' and teachers' reported variables as well as pupils' preferences and talents. Our vector of effort is thoroughly described in Table A1. The relevant QSSMEB questionnaire module is based on the 1988 National Education Longitudinal Study (NELS, 1988), which covers five aspects of students' behaviour in the classroom from a subjective assessment of every sampled pupils by respectively their mathematics and English teachers: (1) how often student performs below ability; (2) how often student submits incomplete homework; (3) how often student is tardy or lazy; (4) how often student is disinterested in class; (5) how often student makes noise being disruptive. While measure (1) is a teacher-perceived effort after comparing observed performance and ability, the other four measures are measures relative to other pupils. Interestingly, most of these measures are related to self-discipline, a socio-emotional skill, which has been shown to matter significantly for educational success by psychologists (see, for instance, Duckworth & Seligman, 2005).[10] While not fully standard as we do not measure homework and study time at home, which have been used in past literature to measure effort at school (De Fraja & Oliveira, 2010; Kuehn & Landeras, 2014; Eren & Henderson, 2011), our vector of teacher-reported effort indicators proxies homework and study time at home with measure (2) (frequency of incomplete homework submission).

For all teacher-reported questions, except noise making, the possible answers were: 'Never', 'Rarely', 'Sometimes', 'Somewhat', and 'Always' (for noise making the answers are 'Never' or 'Rarely'). The most common categories were 'Never', 'Rarely', and 'Sometimes'. We dichotomised these questions' categories (except noise making) by merging 'Never' and 'Rarely', and then combining 'Sometimes' with 'Somewhat' and 'Always' in order to generate the second binomial category.[11]

Additionally, each pupil reports whether they have ever been punished for discipline or bad work by the teacher[12] and whether they have missed one day of school in the last two weeks.[13]

We assume here that adolescents' beliefs and life expectations are strong indicators of their preferences[14] and have an effect on their performance and motivation to work (Dweck, 2002). Moreover, agreement with work ethics drives a taste for effort independently of cognitive abilities (Hsin & Xie, 2014). In order to capture pupils' preferences we used two binary indicators based on pupils' agreement with the following statements: 'people who do not work become idle' and 'work is more important than leisure'.

Talent is seen as stable qualities which can be trained and developed (Spruyt, 2015). We use three proxy measures of pupils' talents based on the following dichotomous indicators: reporting fear of mathematics/English lessons; reporting being popular and reporting they would be sad not to continue studying. Self-perception of ability, especially if low, defines motivation for a study field. We assume that popularity is a talent connected to non-cognitive skills.[15] On the other hand willingness to continue studying is connected to curiosity, which has been shown to enhance cognitive skills (Alberti & Witryol, 1994).[16]

Just below 60% of students believe that lack of work leads to idleness, and about two thirds of students deem work more important than leisure. Fewer than 9% of students report fearing class, while about three quarters of students report both being popular and wanting to study further.

The correlation matrices for all these measures of pupil's effort, preferences and talent are shown in Table A6 (mathematics) and Table A7 (English). We note differences in the correlation patterns within and between groups of effort variables. Between-group correlations tend to be quite low, but within-group correlations include several medium to high values. For instance, the teacher-reported variables as a group have medium to high correlation values (from 0.22 to 0.62 in the case of mathematics, and 0.27 to 0.57 in English). Likewise the two variables capturing pupil's preferences are highly correlated (0.54 in both subjects). Meanwhile the highest pairwise correlations between teacher-reported and pupil-reported variables is only 0.13. This illustrates that effort is a multidimensional concept, bolstering our decision not to neglect any potential effort variables we can include in our analysis.[17]

3.3.4. Social background

Our vector of parental circumstances, thoroughly described in Table A2, is based on empirical studies in inequality of opportunity literature (Ramos & Van de Gaer, 2016; Jusot & Tubeuf, 2013). We measure family social background using dummies of educational attainment for fathers and mothers measuring whether they completed only primary education; did some secondary education; completed up to secondary education; did some tertiary education. The omitted category is incomplete primary education (or less).

We also include indicators of household living conditions as further circumstances potentially associated with student

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[10] We thank an anonymous referee for pointing out that self-discipline constitutes a socio-emotional skill.

[11] This way of proceeding spares us the need to implement ordered multinomial models that do not rely on the proportional odds assumption, which is violated in our dataset whenever we model the effort indicators as a function of family circumstances. Interestingly the original 1988 NELS only allowed for binary responses (NELS, 1988 p. 2–3).

[12] Our hypothesis is that a pupil who considers that he was unfairly punished would not self-report that he was punished to an independent interviewer.

[13] This is a proxy of school attendance (Aker & Ksoll, 2012).

[14] Research in health and psychology shows that adolescents' normative beliefs, especially related to lifestyles (smoking, alcohol, physical activity), do affect their behaviour (Friedman, 1989; Krahé & Bushing, 2014).

[15] Van der Linden, Scholte, Cillessen, Nijenhuis, and Segers (2010) showed that popularity in the classroom is associated to two of the Big Five dimensions: extraversion and emotional stability; we therefore consider that popularity is a non-cognitive skill.

[16] The relevant questions for all the aforementioned indicators are spread throughout the questionnaire. Question related to absence from school are asked much earlier whereas that on punishment much later. The two statements 'people who do not work become idle' and 'work is more important than leisure' used to capture pupils' preferences toward effort are towards the very end of the 60-item student questionnaire.

[17] We also ran a Multiple Correspondence Analysis (MCA) to represent the underlying structure in a vector of discrete variables. The MCA shows that the first component is almost 80% for both the vector of effort variables in mathematics (78%) and in English (74%), which confirms that the effort variables are not mutually orthogonal, despite several pairwise low correlation values.
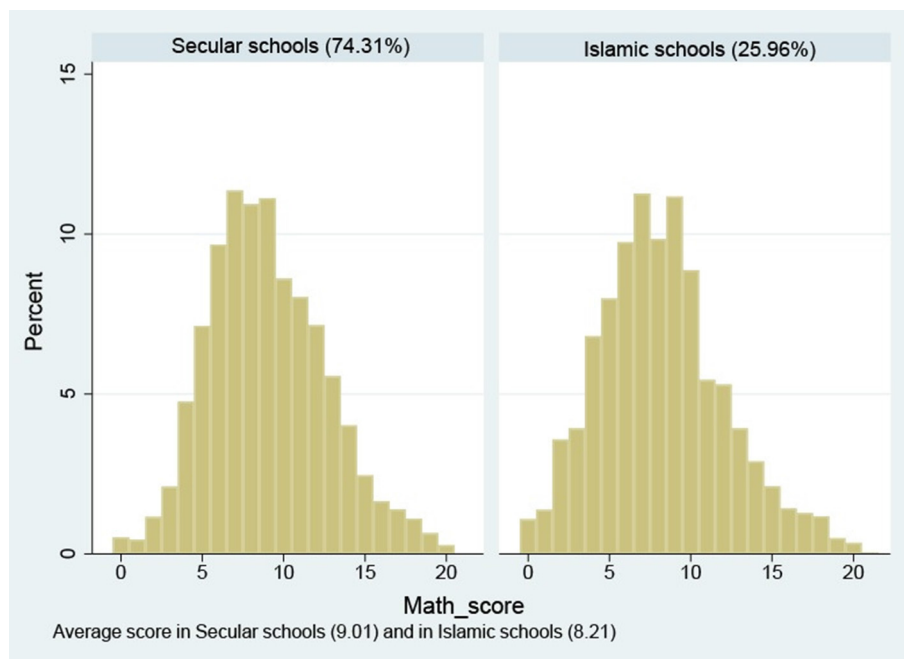
Fig. A1. Distribution of Mathematics test scores – QSSMEB dataset.

performance. This includes purchases of newspapers and magazines, which is an indicator of parental human capital (Ferreira & Gignoux, 2014). We distinguish between (1) households having one of the two items; (2) household having both newspapers and magazines, and (3) households having none of them. Additionally, since the survey sample is in rural Bangladesh, we include whether the household owns farming livestock or not. This provides us with an indication of family wealth.[18]

Finally, we also consider that parents can devote resources either in time or in money to support their child's education (Cunha & Heckman, 2007; De Fraja & Oliveira, 2010). This parental investment is an important input to children's human capital development and we identify it as parental effort toward children's education. We use three measures of parental effort reported by pupils: (1) whether they have a house tutor; (2) whether they go to read in a coaching centre; or (3) neither. The presence of a tutor reflects an investment mix of parental time and money into children's education (Andrabi, Das, & Khwaja, 2012). A coaching centre is similar to after school tutoring in group and it can be a little cheaper than having a one-to-one home tutor. Additionally, we consider whether pupils report receiving help for homework from parents, which is a proxy of parental time investment in their child's education (Baker & Milligan, 2016; Del Boca et al., 2017; Andrabi et al., 2012).

The correlation matrices for all these measures of household circumstances are shown in Table A8 (mathematics) and Table A9 (English) and the descriptive statistics are in Table A3. About 40% of children have mothers with less than complete primary education. Meanwhile about a third of fathers have at least secondary education. About two thirds of households do not have any news items. About a third of rural households do not own livestock. Regarding parental effort in children's education, about a third of students do not benefit from either a house tutor or attend-

ing a coaching center. Only slightly more than a fifth of students receive parental help for homework.

3.3.5. Demographic characteristics and religion

We additionally consider student's age, gender, and religion. The sample is nearly 63% girls.[19] We use four age dummies: (1) 13 years old; (2) 14 years old; (3) 15 years old or older, and the omitted category is 12 years old or younger. Households from religious minorities account for about 7% of the sample.

4. Methodology for the baseline model

As discussed in Section 1, our objective is to obtain robust results both from a statistical and ethical viewpoint. Our study belongs to the branch of the literature which measures inequality of opportunity when effort variables are actually available, an approach labelled *ex post* (meaning after effort has been exercised) by Fleurbaey and Peragine (2013). Several methods have been proposed in this context (see the surveys in Ramos & Van de Gaer (2016) and Roemer & Trannoy (2015)) combining econometric modelling, measurement of inequality and inequality decomposition. The method used in this paper follows the same tradition and expands that of Jusot et al. (2013), who proposed a tractable method for absolute inequality measurement and decomposition. To the best of our knowledge, this method has not been applied yet to decompose variations in school performance indicators.

In the case of test scores, the absolute view of inequality is arguably more sensible than the relative view.[20] If the absolute gap in tests scores increases between two groups, even if scores have improved equi-proportionaly for both groups, it is likely that people will agree that inequality has increased. Perhaps more importantly,

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[18] Our sample strictly covers rural Bangladesh where agriculture is the main source of livelihood and livestocks is a common household (productive) asset.

[19] Bangladesh has experienced a reversal of gender parity in secondary schooling, in the aftermath of the female secondary school stipend scheme. See Asadullah and Chaudhury (2013).

[20] For alternative views of inequality measurement in general see Kolm (1976, 1999, 2009). For recent assessments of educational inequality in particular, see e.g. Dorius (2013, 2017, 2019).
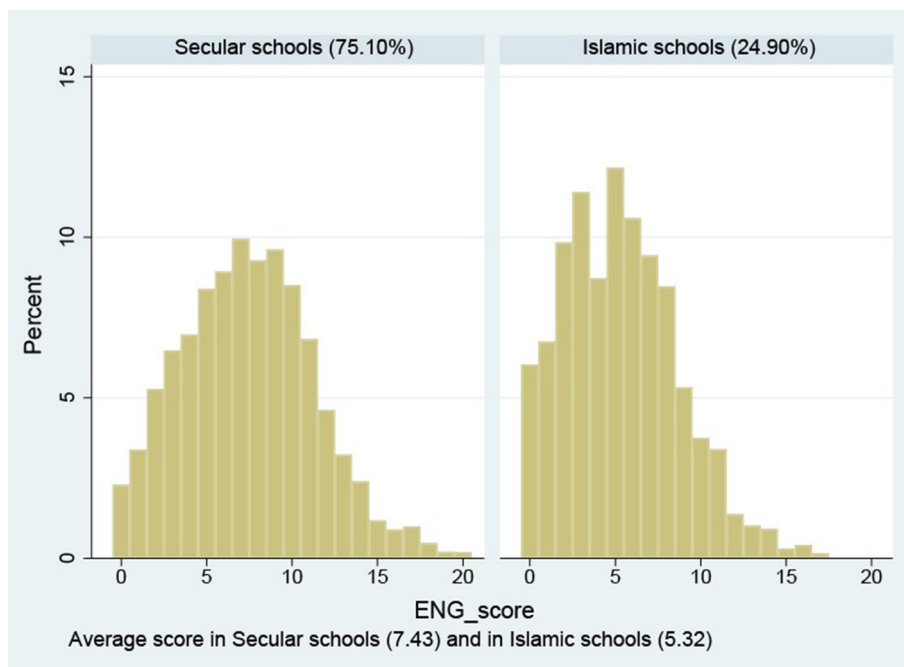
Fig. A2. Distribution of English test scores – QSSMEB dataset.

test scores are bounded (since they have minimum and maximum values) so in principle they can be represented as attainments or shortfalls. But Lambert and Zheng (2011) have shown that absolute inequality measures rank distributions consistently across both representations.[21] We then choose the variance as an absolute inequality measure. The variance presents the technical advantage of belonging to a class of additively decomposable absolute inequality indices (Bosmans & Cowell, 2010), in the sense that it can be decomposed into within-group and between-group components in the same way that Bourguignon (1979), Cowell (1980), and Shorrocks (1980) showed for a class of relative inequality indices.

Our two-part methodology consists of a parametric estimation strategy and a decomposition of the predicted variance of student performance by source (i.e. effort, circumstances, etc.) and by subgroup (i.e. within- and between-schools). We model within-school and between-school variations in performance scores separately (and respectively for English and maths). Because the sample of pupils per school varies greatly and can sometimes be quite small, we consider both a fixed effect and a multi-level, random-effect specification. This allows us to deal with heterogeneity in school quality. In the within-school model we control for any potential source of variation in scores associated with differences between-schools by adding school fixed effects as we have information on the particular school attended by each student (in addition to detailed information on these schools' characteristics). We are however not interested in unpacking the specific features that are more associated with performance score, i.e. we are not estimating the parameters of an 'education production function'; we just control for between-schools variation in the aforementioned manner. Then, in the between-schools models we will use the vector of five dummy variables described previously to measure school-specific traits along with school-level averages of the other

variables (pupils' effort, preferences, and talent; social background; demographics and religion; and teacher characteristics).

Next, we discuss in detail the first part of our methodology, namely parametric estimation of the educational production function. This is followed by an elaboration of the decomposition framework in Section 4.2. We do these with reference to the baseline model (i.e. implementing Barry's view). The methodological framework corresponding to the variant model (i.e. implementing Roemer's approach) is discussed separately in Section 6.

4.1. Estimation phase

We implement and expand on the proposal by Jusot et al. (2013), exploiting the special features of our dataset, chiefly the rich information on schools attended. Since we want to gauge the empirical relevance of the different views as to how the correlation between efforts and circumstances should affect the magnitude of legitimate and illegitimate sources of inequality in education in rural Bangladesh, we model the variation of indicators of student achievement in mathematics (A^m) and in English language (A^l), as functions of a vector of students' demographic and religion variables (D), a vector of efforts, talents and preferences in mathematics (E^m) only included in the equation for mathematics achievement (respectively vector (E^l) of efforts in English), a vector of their social background circumstances (C) including parental effort in their offspring's education, a vector of school characteristics (Q), and a vector of teacher's characteristics in mathematics (T^m) only included in the equation for mathematics achievement (and a respective vector T^l for the English achievement equation). For each equation there is also an error term:

$$A^z = f(D, E^z, C, Q, T^z, u^z) \qquad (1)$$

where the dependent variables of performance scores are deemed continuous, hence Eq. (1) is estimated with a linear model, and $z = l, m$. We consider both a fixed-effect model and a multi-level random effect model to capture the influence of school variation

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[21] In other words, for instance, relative inequality rankings provided by measures like the Gini coefficient or the Lorenz curve may reverse if we switch from an attainment to a shortfall representation.

on the student achievement. Henceforth the subject-specific superscripts (m, l) are dropped for ease of presentation.

Fixed-effect and between-schools variation models

In the baseline model (implementing Barry's view), performance differences due to students' effort, preferences, and talent would need to be fully respected. Therefore, we estimate the following equation:

$$A_{is} = \lambda + \gamma D_{is} + \beta E_{is} + \alpha C_{is} + \delta_s + u_{is} \tag{2}$$

where the i subscripts represent students' individual values for the variables in the respective vectors. The s subscript stands for school. In Eq. (2) the school-specific intercept δ_s stands for school fixed-effects, which enable us to capture as much as possible of the part of the explained variation in the outcome attributable to between-schools effects (in terms of association rather than causation). Yet for this very reason these fixed effects are a sort of 'black box' since between-schools fixed-effects may be embodying effects related to: school quality differences, between-schools circumstances (e.g. affecting school choice), between-schools effort differentials, and between-schools demographics. We discuss a proposal to unpack this 'box' below. In the meantime it is worth checking how Eq. (2) looks when we try to estimate the within-school model with the parameters of the explanatory variables other than the school dummies:

$$A_{is} - A_s = \gamma(D_{is} - D_s) + \beta(E_{is} - E_s) + \alpha(C_{is} - C_s) + u_{is} - u_s \tag{3}$$

where $A_s, D_s, E_s,$ and C_s represent school-level averages for the respective sets of variables. Essentially, Eq. (3) shows that with this current model, we are mainly capturing the *associated* effects of within-school variations in efforts, circumstances, and demographics/religion characteristics on within-school variations in performance scores.

We model, in parallel, between-schools variations in the two outcomes, as functions of between-schools differences in circumstances, efforts, and school-specific characteristics denoted by the vector of school-specific traits Q_s (described in Section 3.3.3) and and the school-level teacher's behaviours T_s:

$$A_s = \pi + \upsilon D_s + \eta E_s + \zeta C_s + \omega Q_s + \epsilon T_s + v_s \tag{4}$$

Given the nature of our educational outcome variables we can use their predicted values from the linear models above as linearly decomposable measures of educational attainment:

$$\widehat{A_{is} - A_s} = \hat{\gamma}(D_{is} - D_s) + \hat{\beta}(E_{is} - E_s) + \hat{\alpha}(C_{is} - C_s) \tag{5}$$

$$\widehat{A_s} = \hat{\pi} + \hat{\upsilon}D_s + \hat{\eta}E_s + \hat{\zeta}C_s + \hat{\omega}Q_s + \hat{\epsilon}T_s \tag{6}$$

where $\widehat{A_{is} - A_s}$ are the predicted deviations of test scores for each individual i from their respective school means, under the baseline model, while $\widehat{A_s}$ are the predicted average scores in school s. The accented coefficients are the estimates from each respective model.

Multi-level, random-effects model.

The fixed-effect model is demanding in terms of degrees of freedom. An alternative is to choose a random-effect specification, which is more parsimonious but assumes that the random school-quality is not correlated to the regressors, which is also a demanding assumption. As recommended in Clarke, Crawford, Steele, and Vignoles (2015), the rich data we have on school-level characteristics call to complement the fixed-effects specification with a random-effects approach[22]. We perform the variance

[22] The random effects assumption implies that unobserved characteristics of the school that can influence performance at school (e.g. ethos or teacher quality are not correlated with pupil, family or school characteristics that are included in the models (Clarke et al., 2015)).

decomposition described in Section 4.2, also relying on multi-level, random-effects models.

In order to track the effect of school-level variables on the variance decomposition, we introduce them in stages. We start with the random-effects baseline model in Eq. (7):

$$A_{is} = \lambda + \gamma D_{is} + \beta E_{is} + \alpha C_{is} + \delta Q_s + \kappa T_s + u_s + u_{is}, \tag{7}$$

where u_s is a school-level random intercept, T_s represents school-level teacher's behaviours and Q_s stands for other school-specific characteristics (described in Section 3.3.3). For comparison purposes we estimate two variants of Eq. (7): (a) an OLS regression with the same vector of dependent and explanatory variables as Eq. (7); and (b) a multilevel, random-effect model adding school averages of pupils' effort, preferences, talents; plus school averages of social background, demographics and parental effort as covariates.

4.2. Decomposition phase

In order to decompose the inequality into legitimate and illegitimate components, we measure absolute inequality with the variance or relative inequality with the squared coefficient of variation, since these are the only inequality measures which are linearly decomposable by sources and fulfil a set of desirable decomposition properties (Shorrocks, 1982). Prior empirical research on educational inequality of opportunity has also used the variance of test scores as an inequality measure (Ferreira & Gignoux, 2014). Since the square coefficient of variation is just the variance divided by the squared mean, then the decomposition for both is the same.

Now we decompose the variances of the predicted test scores by source. Let $\widehat{C_i} = \hat{\alpha}(C_{is} - C_s)$ and $\widehat{C_s} = \hat{\zeta}C_s$ be the parts of the predicted score attributable to social background and parental circumstances in the within-school and the between-schools models, respectively. We allow for similar definitions for the other vector elements. Then the decomposition of the variance of the predicted scores from the within-school variation model is given by:

$$\widehat{\sigma_{WS}^2} = cov\left(\widehat{A_{is} - A_s}, \widehat{D_i}\right) + cov\left(\widehat{A_{is} - A_s}, \widehat{E_i}\right) + cov\left(\widehat{A_{is} - A_s}, \widehat{C_i}\right) \tag{8}$$

Meanwhile, the decomposition of the variance of the predicted scores from the between-schools variation model is given by:

$$\widehat{\sigma_{BS}^2} = cov\left(\widehat{A_s}, \widehat{D_s}\right) + cov\left(\widehat{A_s}, \widehat{E_s}\right) + cov\left(\widehat{A_s}, \widehat{C_s}\right) + cov\left(\widehat{A_s}, \widehat{Q_s}\right) \tag{9}$$

The contribution of effort (plus preferences and talent) to overall explained within-school and between-schools variability, respectively, is given by:

$$cov\left(\widehat{A_{is} - A_s}, \widehat{E_i}\right) = \sigma^2\left(\widehat{E_i}\right) + \rho_{DE}\sigma\left(\widehat{E_i}\right)\sigma\left(\widehat{D_i}\right) + \rho_{CE}\sigma\left(\widehat{E_i}\right)\sigma\left(\widehat{C_i}\right) \tag{10}$$

where ρ_{CE} is the correlation coefficient between the circumstance and effort parts of the predicted score (and same definition for ρ_{DE}) in the within-school variation model; and:

$$cov\left(\widehat{A_s}, \widehat{E_s}\right) = \sigma^2\left(\widehat{E_s}\right) + \rho_{DE}^s\sigma\left(\widehat{E_s}\right)\sigma\left(\widehat{D_s}\right) + \rho_{CE}^s\sigma\left(\widehat{E_s}\right)\sigma\left(\widehat{C_s}\right) + \rho_{QE}^s\sigma\left(\widehat{E_s}\right)\sigma\left(\widehat{Q_s}\right) \tag{11}$$

where ρ_{CE}^s is the correlation coefficient between the circumstance and effort parts of the predicted score (and same definition for ρ_{DE}^s, etc.) in the between-schools variation model.

Likewise we can also define the contributions of the other vectors of variables. Then, we define and compute the total contribu-

tions by adding each model-specific contribution weighted by the relative size of their corresponding model's predicted score variance. For example, the total contribution of effort is given by the following formula:

$$E_{total} \equiv cov\left(A_{is} \widehat{- A_s}, \widehat{E_i}\right) \frac{\widehat{\sigma^2_{WS}}}{\widehat{\sigma^2_{WS} + \sigma^2_{BS}}} + cov\left(\widehat{A_s}, \widehat{E_s}\right) \frac{\widehat{\sigma^2_{BS}}}{\widehat{\sigma^2_{WS} + \sigma^2_{BS}}} \quad (12)$$

We define the total contributions of the other vectors of variables in the same way as in Eq. (12) in both the baseline model and its modification to accommodate Roemer's view (Section 6).

5. Results of the baseline model

This section presents baseline results corresponding to our two-part analysis: (i) estimates of educational production function and (ii) decomposition of educational inequality (variance of test scores). Results relating to the variant model are presented in Section 6. Except when explicitly indicated, the discussion will focus on the results pertaining to the combination of the fixed-effect (within-school) model with the between-schools OLS model since we found that for both performance scores, and in both models (baseline and variant), the fixed-effects specification is at least as consistent as the multilevel random-effects model, thus preferred according to Hausman tests.[23] Lastly, when we state that a right-hand side variable is statistically significant, or significantly associated with a left-hand side variable, we mean a significance of at most 5%.

5.1. Results of the estimation phase

Tables A10, A11, A12 in the Appendix show the results for the baseline models reflecting Barry's view and for both test scores. With the exception of punishment and preference of work over leisure, all effort variables are positively and significantly associated with the mathematics score in the within-school and multilevel models. Parental education dummies are positively related to the score in that any level is associated with better scores vis-à-vis the omitted category of less than complete primary education (with the exception of father's unknown education which is not statistically significant). Regarding individual demographic variables, being a female student significantly decreases by more than one point the mathematics score; while the association between higher age and mathematics score has an inverted-U shape, but is not significant. Being from a minority religious group is negatively associated with the score. Finally, while house tutors and coaching centres relate positively and significantly to the score, parental help for homework does not.

Concerning the English language score, all effort dummies are statistically significant and positively related to the score in the within-school and multilevel models. Both father and mother's education levels are positively associated with higher scores vis-a-vis the baseline category (except for mother's unknown education level). As with the case of mathematics, girls from religious minority households perform worse than their male and/or religious majority peers. Parental efforts in the form of tutors, coaching centres and help with homework are all positively associated with higher English test scores.

Regarding the between-schools regression results for each score in the baseline model, it is worth noting that these estimations seek to model the between-school variance and are undertaken on a small sample of observations (311 schools); therefore the esti-

mates are less precise, which could explain why so few significant associations are observed. For the mathematics score, only punishment among the effort variables is statistically significant, besides being positively associated with the score. Parental education variables are not generally statistically significant, except for mother's higher education. Between-schools variation in mathematics score is negatively and significantly associated with lack of livestock ownership. A higher proportion of boys correlates positively and significantly with higher average mathematics scores. Among the school-specific characteristics, availability of a computer, being a secular school (vis-à-vis Islamic schools) and entry selection criteria are all positively and significantly associated with the mathematics score.

As for the English score, none of the efforts are significantly associated with the score with the exception of punishment, which is positively and significantly associated with the English score between schools. Schools with higher proportions of girls perform more poorly on average in English test scores. A number of school traits are significantly associated with the variance in English score: being an Islamic school is negatively associated with the score, while the availability of a computer is positively associated with the score.

Table A12 shows the results for the multi-level regressions with school averages for English and mathematics, respectively for the baseline model. In the case of mathematics all individual effort variables associate positively with scores, and only punishment and view on absence of work make you idle are not statistically significant. Most parental education variables correlate positively with scores, but only higher education indicators for parents appear statistically significant, as is ownership of two news items. Restrictive entry selection criteria, presence of computer, house tutoring, coaching centre, and male gender all associate positively with higher mathematics scores. In the case of English, the results are very similar but now more parental education indicators appear statistically significant. Additionally recognised Islamic schools carry a statistically significant penalty in the form of lower English scores.

5.2. Results of the decomposition phase: within-school and between-school variations

Table 1 shows the results of the decomposition exercise for each test score relying on the within-schools and between-schools variation models. For further illustration and comparison purposes, we introduce the vectors of variables in blocks. As usual, as long as we go from the left to the right, the model is more complete. The first two columns of results to the left show an OLS model using the same variables as in the within-school variation, fixed-effects model (same as the "within-schools" rows of the two right-most columns) plus vectors of school-specific teacher behaviours and school characteristics. Then these same variables are considered in a multilevel, random-effects model whose results are in the third and fourth columns of results. Then, we add a vector of school-average variables (in the rows right below the "between-schools" headings) and estimate multilevel, random-effects models with decomposition results in the fifth and sixth columns of results. Finally, the two right-most columns show results from combining a within-school, fixed effects model with an OLS model of school averages (i.e. a between-schools variation model).

Focusing on the most complete models (four rightmost columns), a first noteworthy result is that between-schools inequality represents roughly 2/3 of total inequality. This result is in tune with what we know about schooling inequality in developing countries where between-schools variation dominates (see OECD, 2013 Figure II.2.7, p. 47). The breakdown of the contributions of each source into within-schools and between-schools contexts

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[23] The Hausman test displayed Chi2(34)=79.63 with P-value = 0.000 (English - baseline), Chi2(34)=464.41 with P-value = 0.000 (English - Roemer adaptation); Chi2(34)=332.03 with P-value = 0.000 (mathematics - baseline), and Chi2(34)=126.72 with P-value = 0.000 (mathematics - Roemer adaptation).

underlines that pupils' efforts, preferences, and talents are the major source of the within-schools variation in English, whereas it is demographics in the decomposition of the within-schools variation in mathematics. By contrast, the variables' relative contributions to between-schools variation are much more similar between the two scores, with the main differences being in the roles of pupils' efforts more prominent in mathematics, and school characteristics more important in English. Average family circumstances play a prominent role in the between-schools share for the two scores.

Strikingly, the relative importance of demographics (and religion) depends on the subject. In the case of mathematics, demographic characteristics are equally or more important (depending on the model) than the sum of the contributions of effort, talent, and preferences in their contribution to within-school variation, explaining almost half of the predicted score variance within-schools. By contrast, demographics/religion characteristics explain less than 10% of within-school variation in predicted English scores. Meanwhile, for both scores, the contribution of demographics/religion characteristics to between-schools variation is negligible.

School traits and teacher behaviours contributed about 30% of the variance in between-schools mathematics score, and about 38% in English score, without major difference between the two models. The overall combined contribution to total variance stands at about 22% for maths and 28% for English.

5.3. Results of the decomposition phase: overall variation

Table 2 shows the relative contribution of each vector of variables to the predicted variances of scores for mathematics and English, under the baseline and the Roemer-adapted models. The four pairs of results correspond to the models considered in Table 1. We note that, as expected, both the complete multi-level model and the combined within-plus-between-schools variation models produce larger predicted variances. Interestingly, the combined within-plus-between model (where within-school variation is modelled using school fixed-effects) yields a larger predicted variance vis-à-vis the complete multi-level model, albeit at the cost of fewer degrees of freedom.

We learn several interesting lessons from Table 2, focusing on the most complete models. Firstly, social background combined with parental effort (together labeled as "family circumstance") explain about a quarter of total predicted variation, climbing up to around 30% in the Roemer model. Secondly, gender, age, and religion play a significantly larger role in mathematics (14%-16% in the baseline model) than in English (3%-4% in the baseline model). This is compensated by the more prominent roles played by teacher and school characteristics (an extra 5–7 percentage points) as well as pupil's efforts, talent and preferences (an extra 3–5 percentage points) in English vis-à-vis mathematics.

Thirdly, all the decompositions based on the most complete models deliver the same message: for both test scores and across both models, the main contributor to total predicted inequality is pupil's effort, preferences, and talent, i.e. the component of legitimate inequality. They are followed by family circumstances and school and teacher characteristics in second and third position depending on the subject (family circumstances being second in mathematics, but third in English). Meanwhile, as mentioned, demographic and religious traits play only a noteworthy role in mathematics.

Finally, the magnitude of each main factor does vary significantly across subjects, except for family circumstances. In particular, the contributions of pupil's effort, talent and preferences are significantly lower in Maths. Without further inquiry, we can only propose speculative explanations based on the literature. For

instance, there is evidence of so-called "math anxiety" (Ashcraft, 2002; Punaro & Reeve, 2012; Dowker, Sarkar, & Looi, 2016) which could be mediating the relation between effort variables and performance in mathematics dampening their statistical association. True, among our pupil's talent variables, we have a variable reporting fear of maths class or English class and a bit less than 10% of students report fear of the subject. And so apparently, we control for fear. However, Punaro and Reeve (2012) suggest that although mathematics is not the only subject eliciting anxiety, the problem may indeed be more severe, and possibly affect performance more, in mathematics than in other subjects. Our conjecture here is that our control of fear is imperfect.

6. The variant model: coping with the correlation between effort and circumstances

We now show how the estimation strategy needs to be modified in order to incorporate Roemer's view, by cleansing effort's impact from the correlation with circumstances. Next we see whether the estimation and decomposition change when the observed effort is replaced by its orthogonalized counterpart.

6.1. Amended methodology

In Roemer's view we only need to respect differences due to effort, preferences and talents, which are orthogonal to circumstances (i.e. social background, demographics/religion characteristics, etc.). Hence, as a first step, Jusot et al. (2013) proposed using a set of auxiliary equations in which the effort variables (here expanded to include preferences and talents) are modelled as a function of circumstances:

$$E_{is} = \xi + \ni D_{is} + \mu C_{is} + \phi_s + e_{is}, \tag{13}$$

where e_{is} is a vector of residual terms. Eq. (13) refers to the fixed-effect specification for the within-school model (where the school fixed effects are denoted by ϕ_s). Since our efforts, preferences and talents are binary variables we estimate Eq. (13) with Probit models. Then, as a second step, we replace E_{is} in Eq. (3) with $\widehat{e_{is}}$ the estimated vector of residuals from Eq. (13). They are described below as orthogonalized effort and they are actually generalised residuals stemming from a non-linear model.[24] In the case of the variant model, Eq. (2) becomes:

$$A_{is} = \lambda + \gamma D_{is} + \beta \widehat{e_{is}} + \alpha C_{is} + \delta_s + u_{is} \tag{14}$$

The procedure then yields:

$$A_{is} - A_s = \gamma(D_{is} - D_s) + \beta(\widehat{e_{is}} - \widehat{e_s}) + \alpha(C_{is} - C_s) + u_{is} - u_s \tag{15}$$

For both the multi-level random-effects model and the between-group variation models we remove the school-specific intercepts, and include both Q_s, i.e. the school-quality traits, and T_s in Eq. (14). Then we introduce the respective predicted residuals into equations Eq. (4)–(7) instead of the observed variables of effort, preferences and talents.[25]

Finally, in order to incorporate Roemer's view, the decomposition procedure described in Section 4.2 now depends on the parts of the predicted tests scores generated from the within-school and between-schools models, re-estimated with the predicted residuals from Eq. 13 instead of the observed effort variables. The formulas are the same as those used for the decomposition relying on the

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[24] See Appendix A in Jusot et al. (2013) for the technical details.

[25] If the auxiliary equations were estimated with linear models, then the coefficients in Eq. (14) would be exactly the same as those in Eq. (2) according to the Frisch-Waugh-Lowell theorem. However, the coefficients are different, because in the Roemer modification of the baseline model, the effort residuals are estimated via non-linear regressions owing to the binary nature of the effort measures available.

Table 2
Decomposition of educational inequality by source, overall variation.

	OLS		Multilevel Random-effect		Multilevel Within-schools		Combined Between & Within	
English	**Barry**	**Roemer**	**Barry**	**Roemer**	**Barry**	**Roemer**	**Barry**	**Roemer**
Total predicted variance	2.90		2.40		3.28		4.08	
Pupil's effort, talent preferences (%)	37.32	31.73	36.01	30.41	37.56	33.73	40.14	37.76
Family circumstances (%)	12.60	16.95	10.67	14.76	24.67	28.08	27.73	31.33
School, teacher characteristics (%)	47.34	47.53	49.77	49.89	34.51	34.91	28.22	27.94
Pupil's age, gender, religion (%)	2.74	3.78	3.55	4.94	3.27	3.29	3.91	3.44
Mathematics	**Barry**	**Roemer**	**Barry**	**Roemer**	**Barry**	**Roemer**	**Barry**	**Roemer**
Total predicted variance	1.95		1.68		2.77		3.32	
Pupil's effort, talent, preferences (%)	31.81	27.07	24.08	20.24	33.31	30.57	35.20	32.16
Family circumstances (%)	12.54	17.64	7.00	10.04	25.05	28.69	26.87	30.46
School, teacher characteristics (%)	35.77	35.98	43.34	43.49	27.22	27.41	22.30	22.43
Pupil's age, gender, religion (%)	19.88	19.31	25.57	26.23	14.44	13.33	15.63	14.95

Pupil's effort includes seven binary indicators, pupil's preferences is based on two binary indicators, and pupil talent comprises three binary indicators. They are all described in Section 3.3.3. Social background includes four dummy variables of educational level completed for each parent, plus newspaper purchases, and a binary indicator of livestock ownership. Parental effort uses three binary indicators: having a house tutor, reading in coaching center, and receiving parental help. Teacher's behaviours includes indicators of frequency of meetings with parents, frequency of tests and pupil attendance. Finally, school characteristics include: a binary indicator for being a recognised Islamic school, a binary indicator of school admission policy, and binary indicators for possessions of computer and library.

baseline model (Eq. (8)–(12)) but the model coefficients will be different and the observed effort variables are replaced by their respective predicted residuals from Eq. (13).

In substance, observed efforts are replaced by orthogonalized efforts which are obtained as residuals from an auxiliary equation where effort variables are regressed on the full set of circumstances. Once this is done, the rest of the statistical procedure remains the same.

6.2. Results from the estimation and decomposition phases

Let us first summarise the key message coming out of our estimation results.

The correlation between effort and circumstances is weak, rendering the distinction between Barry's and Roemer's stances less meaningful empirically in the Bangladesh context than in the realm of philosophical ideas. Even if this is a 'negative result', it is important information nonetheless.

Tables A13 and A14 and Tables A15 and A16 show the respective auxiliary equations of effort, preferences and talent for mathematics and English related to Eq. (13) as functions of the circumstances (including parental, household, school effects, and own demographic/religion characteristics).

Regarding effort in mathematics, there are few consistently significant patterns in terms of marginal effects of the same variable across different efforts as dependent variables. As somewhat of a pattern, paternal education stands out with larger and more often statistically significant coefficients vis-à-vis maternal variables (eight equations with at least one statistically significant coefficient for paternal education variables versus six for maternal education, out of twelve effort equations).

As in the case of the mathematics auxiliary equations, few significant patterns of marginal effects can be found across equations in effort in English; however, more father's education dummies than mother's (seven occurrences instead of four), again, have positive marginal effects. Since the omitted educational category is incomplete primary education, these effects mean that having complete primary education or more is associated with better

efforts. Interestingly, our first empirical finding is that effort is only loosely related to parental background[26].

Tables A17, A18, A19 shows the results for both scores under the variant model. In view of the results of the auxiliary equations, it is not surprising that for both scores, the results are remarkably similar to those in the baseline model in terms of direction of association (parental help at homework is now positively associated with higher mathematics scores). As expected, the estimated coefficients of the residual effort variables are deflated compared to the baseline model. On the other hand, the estimated coefficients of the variables labelled as circumstances, including parental and household background, are larger than in the Barry case.

Regarding the results for the between-schools regression model of mathematics and English scores under the variant model, they are remarkably similar to those in the baseline model for both scores. As underlined in the within-school estimations, the variant model leads to deflated estimated coefficients for the residuals variables and inflated estimated coefficients for the circumstances-related variables.

Table A19 shows the results for the multi-level regressions with school averages for mathematics and English under the variant model. As before, the results are very similar to those of the multi-level regression in Tables A17 and A18, but effort variables feature marginally smaller association coefficients. At the end of the day, the important message in relation with the aim of the paper that stands out from all the estimations is that there are always effort variables that are significant at both stages.

Regarding the decomposition results from Table 1, a first prominent feature, whichever the statistical model, is the lack of substantial difference in magnitude between the decomposition results based on the baseline and variant models. Indeed, the differences in the contributions of each specific category of variables

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[26] We estimated the effort equations with only demographic characteristics and then we added the circumstances on the right-hand side. We used the likelihood ratio test to test the null hypothesis that the coefficients of the circumstance vector are jointly zero. The null hypothesis is rejected at 5% (or less) in every equation (results available upon request). We note an increase in explanatory power stemming from the circumstance vector but it still remains small. The correlation between each effort and the vector of circumstances is weak but does exist.

(e.g. social background), as well as in the within- and between-schools components are never very large. For instance, in the case of English scores and the model combining separate estimations of within- and between-schools variation (two right-most columns), the maximum difference between the two models (baseline and variant) is 1.37 percentage points, corresponding to the contribution of social background in the within-school model. Meanwhile, in the case of Mathematics scores using the same combined model, the maximum difference is 1.81 percentage points, corresponding to the contribution of social background in the between-schools model. This is in line with the results of the estimation phase where we do not find many circumstances substantially altering pupils' overall effort. In sum, the distinction between the baseline model reflecting Barry's view and the variant model incorporating Roemer's can be neglected in a first approximation.

While beyond the scope of this paper, this "negative result" begs an explanation, partly related to the key question as to the ultimate drivers of effort. Perhaps, some of the relevant parental and household factors are unobservable (though we did account for often unavailable information on parental effort). Alternatively, peer effects might be more important than parental traits (Harris, 1998) (though we controlled for the former in our models). A third option involves a degree of a student's individual agency which cannot be attributed to any particular environmental factor. In the absence of additional observable factors in our dataset, this would be a possible interpretative consequence by default. But we should not rule out the potential role of some contextual features specific to rural Bangladesh such as the relative low level of inequality in some monetary indicators of well-being (Osmani & Sen, 2011), and the relative cultural homogeneity of the population (as exemplified by the prominence of Hanafi Sunni Islam).[27]

7. Conclusion

We used a unique dataset on secondary schools' inputs and outcomes in rural Bangladesh to evaluate the importance of effort relative to circumstances in student performance. We found that various measures of pupil's effort, preferences, and talent, jointly explain between one third and two fifths of the explained variance in mathematics and English. This result undermines the idea that educational achievement should be considered as a circumstance in the assessment of inequality of opportunity in income acquisition (or related adult advantages) in every context. In the absence of data to measure effort, the role of circumstances could therefore be biased and overestimated.

The remaining explained part is clearly beyond children's control, whether they be parental background variables, gender, age or school quality. In particular, school quality is important since it might be thought that there is a possibility of manoeuvre for an improvement in educational public policy. If we were able to level up the playing field in terms of school quality, inequality of opportunity would decrease by about at least a quarter. We must remain prudent here, because we explicitly avoid claiming that we have anything above and beyond evidence of association between educational input and outcome.

An important caveat is in order. Our results cannot be interpreted in terms of causal relationships because we lack sources of exogeneity. For example we cannot control for the geographical distances from school. We only claim that we are measuring the strength of associations between variables, arguably a first step toward a causal analysis. We have a rich description of the behaviour of pupils, we observe parental educational effort and we can control for teachers' behaviours providing a proxy for their effort. However intelligence tests, like IQ (Intelligence Quotient) or RPM (Raven's Progressive Matrices), are not available and our measure of school performance and pupils' effort, preferences, and talent are based on observable reported variables. Such tests would measure cognitive talent and we lack a measure of pure cognitive talent in the school context.[28] Nevertheless, our paper offers a partial solution to address the concerns on measures of pure cognitive talent since we use three proxies for pupil's personality, cognitive, and non-cognitive talent. We consider self-reported 'being popular among others in class' as a personality trait, relying on the finding by Borghans et al. (2016) that personality is a bigger driver of performance than IQ scores.

The magnitude of each main factor seems robust to the statistical methods used (based on an ethical view regarding the correlation between effort and circumstances). Indeed, a main surprise, in particular regarding the sociology literature, is that effort is almost orthogonal to parental background. Thus, the dilemma raised by the controversy between Barry (2005) and Roemer (1998) on the appropriate way to account for effort in Asian students here lacks an empirical support.

Finally, we cannot assume that the relative contribution of each main factor, effort, parental background, school quality and demographics in explaining inequality of opportunity of educational outcome is representative of any general pattern in any other context different from rural Bangladesh. But the results are sufficiently new to call for similar studies in other social settings and in particular in other developing societies.

CRediT authorship contribution statement

M. Niaz Asadullah: Conceptualization, Validation, Investigation, Resources, Writing - review & editing. **Alain Trannoy:** Conceptualization, Methodology, Validation, Writing - review & editing. **Sandy Tubeuf:** Conceptualization, Methodology, Validation, Formal analysis, Writing - original draft, Writing - review & editing. **Gaston Yalonetzky:** Conceptualization, Methodology, Software, Formal analysis, Visualization, Writing - original draft, Writing - review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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[27] That is, the rural Bangladeshi context stands in sharp contrast to other societies where cultural heterogeneity constitutes a major determinant of variation in student effort (e.g. see Stevenson & Lee, 1990; Hsin & Xie, 2014).

[28] However Borghans, Golsteyn, Heckman, and Humpries (2016) argue that grades and achievement scores are better predictors of market outcomes than IQ, because educational achievement captures personality traits that have independent predictive power beyond IQ's. Additionally psychologists have shown that IQ result is not immune from motivation (see Duckworth, Quinn, Lynam, Loeber, & Stouthamer-Loeber (2011) and Almlund, Duckworth, Heckman, & Kautz (2011)) and that IQ explains school achievement much less successfully than self-discipline (see Duckworth & Seligman (2005)).

Appendix A

Table A1
Detailed description of the pupil's overall effort: school effort, preferences, and talent

Domains	Variables (proxies)	Reported by	Interpretation	Supporting literature
Pupil's school effort			These measures of effort are related to self-discipline. When these measures are reported by the teacher they are effort of one pupil relative to others in her class except the first measure.	Duckworth and Seligman (2005) Peterson and Woessmann (2007)
	How often student performs below ability	Teacher	By comparing performance (observed) and ability that the teacher a can test in classroom, he then deduces a perceived effort variable.	Alexander and Entwisle (1987) Roscigno and Ainsworth-Darnell (1999)
	How often student submits incomplete homework	Teacher	This measure is a proxy of hours per week doing homework or time spent per day on school-related homework.	Brookhart (1998) Katsillis and Rubinson (1990) Kuehn and Landeras (2014) De Fraja and Oliveira (2010)
	How often student is tardy or lazy	Teacher	This measure is a proxy of elements of the broad construct of effort related to schoolwork such as responses to "Goof off in school"; "Put off studying as long as I can"; "Try hard to do my best in school"; and "Try harder if I get b".	Brookhart (1998)
	How often student is disinterested in class	Teacher	This measure is a proxy of elements of the broad construct of effort related to schoolwork such as responses to "Ask the teacher or a friend for help as soon as I run into a problem at school"; "Give up when I don't understand a problem right away"; "Discuss serious things with my friends rather than fool around"; "Do the things I want to do first and leave my studying and other work to the last minute".	Brookhart (1998)
	How often student makes noise (being disruptive)	Teacher	It is also a proxy of elements of the broad construct of effort related to schoolwork such as responses to "Discuss serious things with my friends rather than fool around"; "Try hard to do my best in school"; "Do the things I want to do first and leave my studying and other work to the last minute"; "Try harder if I get b".	Brookhart (1998)
	Ever been punished for discipline or bad work by the teacher	Pupil	This measure is a proxy of school behaviour; it captures disciplinary orientation (eg. being non-disruptive) of the child.	Rutter (1983)
	Have missed one day of school n the last two	Pupil	This measure is a proxy of classroom attendance.	Aker and Ksoll (2012) Stinebrickner and Stinebrickner (2008)
Pupil's preferences			Beliefs and expectations for life from adolescents are strong indicators for preferences and normative beliefs in adolescents affect their behaviour.	Friedman (1989) Krahé and Bushing (2014) Dweck (2002)
	Reported agreement with "people who do not work become idle"	Pupil	Belief that work is important for success has an effect on pupil's motivation to work at school as well as on performance	Nicholls (1978)
	Reported agreement with "work is more important than leisure"	Pupil	Agreement with work ethics drives a taste for effort independently of cognitive abilities.	Hsin and Xie (2014)
Pupil's talent			Talent is seen as stable qualities, which can be trained and developed.	Spruyt (2015)
	Reporting fear of math/English lessons	Pupil	Self-perception of ability defines motivation and low perception of ability will lead to avoid that domain.	Dweck (2002)
	Reporting being popular in class	Pupil	This talent is connected to non-cognitive skills and is associated to two of the Big Five dimensions: Extraversion and Emotional Stability	Van der Linden et al. (2010)
	Reporting to be sad not to continue studying	Pupil	This talent is connected to curiosity, which enhances cognitive development and skills.	Alberti and Witryol (1994)

Table A2
Detailed description of the circumstances: social background and parental effort.

Domains	Variables (proxies)	Reported by	Interpretation	Supporting literature
Social background			Family characteristics play a central role in shaping children's outcome, especially education and pupils cannot be held responsible for their family background and other inherited circumstances according to the equality of opportunity literature.	Ramos and Van de Gaer (2016) Jusot and Tubeuf (2013)
	Mother education	Pupil	This measure is a proxy of the social status as well as the skills of the mother and widely used as a circumstance in the equality of opportunity literature.	Ferreira and Gignoux (2014) Cunha and Heckman (2007) Borg (2013)
	Father education	Pupil	This measure is a proxy of the social status as well as the skills of the father and widely used as a circumstance in the equality of opportunity literature.	Ferreira and Gignoux (2014) Cunha and Heckman (2007) Borg (2013)
	Purchase of newspaper and magazines	Pupil	This measure is an indicator of parental human capital, it is a proxy of books or cultural items available in a household, which has been shown to be a major factor to increased literacy and numeracy in children	Ferreira and Gignoux (2014)
	Ownership of farming livestock	Pupil	This measure shows a household socioeconomic assets ownership and is an indicator of family wealth.	Emran et al. (YYYY)
Parental effort			Parents can devote resources either in time or in money to support their child's education. This represents their effort and altruism toward the child. Parents' participation in child's school is seen as human capital.	Cunha and Heckman (2007) De Fraja and Oliveira (2010) Haveman and Wolfe (1995)
	Report having a house tutor	Pupil	This is an indirect measure of parental effort where material resources are relevant. The presence of a tutor reflects an investment mix of parental time and money in child's education.	Pallegedara and Mottaleb (2018) Aker and Ksoll (2012)
	Report going to read in a coaching centre	Pupil	Families pay for coaching centre. Pupils receive supplementary tutoring in groups at the centre. It can be a little cheaper than a one-to-one home tutor. This is seen an parental investment.	
	Report receiving help help for homework from parents	Pupil	This measure is a proxy of parental time investment in the child's education. Parents' time is an important input to children's human capital development	Aker and Ksoll (2012) Baker and Milligan (2016) Del Boca et al. (2017)

Table A3
Descriptive statistics.

Variables	English sample	Maths sample
Pupil's overall effort†		
Pupil's school effort		
Never/rarely perform low	69.00 (0.46)	62.94 (0.48)
Never/rarely incomplete work	69.65 (0.46)	68.58 (0.46)
Never/rarely lazy	73.57 (0.44)	77.80 (0.42)
Never/rarely disinterested	67.53 (0.47)	76.17 (0.43)
Never noisy vs. rarely	21.38 (0.41)	69.75 (0.46)
Never punished	79.28 (0.40)	78.94 (0.41)
Not absent past 2 weeks	35.10 (0.48)	35.21 (0.48)
Pupil's preferences		
If no work becomes idle	58.98 (0.49)	59.00 (0.49)
Work preferred to leisure	66.07 (0.47)	65.86 (0.47)
Pupil's talent		
Fear class	8.60 (0.28)	8.56 (0.23)
Being popular in class	75.38 (0.43)	75.98 (0.43)
Want to study further	76.19 (0.43)	76.26 (0.43)
Demographic characteristics and religion		
Average age in years	13.10 (1.00)	13.10 (1.01)
Non Muslim	7.29 (0.26)	7.27 (0.26)
Female	62.85 (0.48)	62.59 (0.48)
Social background and parental efforts‡		
Mother no education	16.34 (0.37)	16.83 (0.37)
Mother incomplete primary	23.34 (0.42)	23.53 (0.42)
Mother complete primary	19.23 (0.39)	18.60 (0.39)
Mother incomplete secondary	16.70 (0.37)	16.68 (0.37)
Mother complete secondary	13.12 (0.34)	12.96 (0.34)
Mother some tertiary	6.68 (0.25)	6.60 (0.25)
Mother education unknown	4.56 (0.21)	4.77 (0.21)
Father no education	14.21 (0.35)	14.36 (0.35)
Father incomplete primary	14.94 (0.36)	15.29 (0.36)
Father complete primary	11.83 (0.32)	11.77 (0.32)
Father incomplete secondary	17.04 (0.38)	16.83 (0.37)
Father complete secondary	15.98 (0.37)	15.95 (0.37)

Table A3 (*continued*)

Variables	English sample	Maths sample
Father some tertiary	17.90 (0.38)	17.67 (0.38)
Father education unknown	8.06 (0.27)	8.10 (0.27)
No news item	63.34 (0.48)	62.90 (0.48)
One news item	26.80 (0.44)	26.98 (0.44)
Two news items	9.86 (0.30)	10.12 (0.30)
Ownership of farming livestock	34.34 (0.47)	34.14 (0.47)
Parental effort		
House Tutor	28.42 (0.45)	28.32 (0.45)
Coaching centre	36.02 (0.48)	35.40 (0.48)
Parental help with homework	22.38 (0.42)	22.30 (0.42)
School characteristics		
School admits from any primary school	66.52 (0.47)	65.86 (0.47)
Islamic school	24.90 (0.43)	25.69 (0.44)
School has a library	57.21 (0.49)	57.35 (0.49)
School has a computer	51.82 (0.50)	52.48 (0.50)
Teacher-specific behaviours		
Meet parents every 1 month	24.66 (0.43)	26.09 (0.44)
Meet parents every 3 months	15.48 (0.36)	17.95 (0.38)
Meet parents every 6 months	10.51 (0.31)	7.28 (0.26)
Meet parents if needed	49.33 (0.50)	48.67 (0.50)
Do at least 4 tests a year	86.73 (0.34)	26.95 (0.44)
Almost all pupils attend class	41.76 (0.49)	42.13 (0.49)

Standard deviations presented in parenthesis.
The study was carried out in 311 schools with a study sample of 7,923 for English and 7,949 for Mathematics.
The average number of children assessed per sampled school was 38.61 for English and 39.29 for Mathematics.
†Pupil's overall effort measures are described in Table A1.
‡Social background and parental effort are described in Table A2.

Table A4
Variables by type of schools - English sample.

English	Secular schools n = 5,950		Islamic schools n = 1,973	
Variables	**Mean**	**SD**	**Mean**	**SD**
English score	7.43	3.88	5.32	3.35
Pupil's overall effort†				
Pupil's school effort				
Never/rarely perform low	0.69	0.46	0.69	0.46
Never/rarely incomplete work	0.70	0.46	0.68	0.47
Never/rarely lazy	0.72	0.45	0.78	0.41
Never/rarely disinterested	0.65	0.48	0.76	0.43
Never noisy (vs. rarely)	0.23	0.42	0.17	0.37
Never punished	0.79	0.41	0.80	0.40
Not absent past 2 weeks	0.35	0.48	0.34	0.47
Pupil's preferences†				
If no work becomes idle	0.61	0.49	0.53	0.50
Work preferred to leisure	0.68	0.47	0.61	0.49
Pupil's talent†				
No fear English class	0.08	0.28	0.09	0.29
Being popular in class	0.74	0.44	0.81	0.39
Want to study further	0.77	0.42	0.75	0.43
Social background‡				
Mother no education	0.16	0.37	0.19	0.39
Mother incomplete primary	0.23	0.42	0.25	0.43
Mother complete primary	0.18	0.39	0.20	0.40
Mother incomplete secondary	0.17	0.37	0.17	0.37
Mother complete secondary	0.13	0.34	0.12	0.32
Mother some tertiary	0.08	0.26	0.04	0.19
Mother education unknown	0.05	0.21	0.05	0.21
Father no education	0.14	0.34	0.17	0.37
Father incomplete primary	0.15	0.36	0.16	0.37
Father complete primary	0.12	0.32	0.12	0.33
Father incomplete secondary	0.17	0.38	0.16	0.37
Father complete secondary	0.16	0.37	0.16	0.37
Father some tertiary	0.19	0.39	0.14	0.35
Father education unknown	0.08	0.27	0.08	0.27
No news item	0.61	0.49	0.67	0.47

Table A4 (*continued*)

English	Secular schools n = 5,950		Islamic schools n = 1,973	
Variables	Mean	SD	Mean	SD
One news item	0.28	0.45	0.25	0.43
Two news items	0.11	0.31	0.07	0.26
Ownership of farming livestock	0.35	0.48	0.32	0.46
Parental effort‡				
House Tutor	0.31	0.46	0.21	0.41
Coaching centre	0.38	0.48	0.29	0.45
Parental help with homework	0.23	0.42	0.19	0.39
Demographic characteristics and religion				
Age	13.04	0.95	13.30	1.14
Non Muslim	0.09	0.29	0.01	0.09
Female	0.62	0.49	0.66	0.47
School characteristics				
School admits from any primary school	0.67	0.47	0.64	0.48
School has a library	0.56	0.50	0.59	0.49
School has a computer	0.54	0.50	0.46	0.50
Teacher behaviours				
Meet parents every 1 month	0.25	0.44	0.22	0.42
Meet parents every 3 months	0.17	0.38	0.10	0.30
Meet parents every 6 months	0.09	0.29	0.14	0.35
Meet parents if needed	0.48	0.50	0.54	0.50
At least 4 tests a year	0.86	0.35	0.90	0.30
Almost all pupils attend class	0.43	0.50	0.37	0.48
Average number of pupils assessed per school	43.55	25.25	23.72	13.45

‡Social background and parental effort are described in Table A2.
†Pupil's overall effort measures are described in Table A1.

Table A5
Variables by type of schools – Maths sample.

Mathematics	Secular schools n==5,907		Islamic schools n==2,042	
Variables	Mean	SD	Mean	SD
Mathematics score	9.01	3.63	8.22	3.88
Pupil's overall effort†				
Pupil's school effort				
Never/rarely perform low	0.63	0.48	0.64	0.48
Never/rarely incomplete work	0.69	0.46	0.68	0.47
Never/rarely lazy	0.77	0.42	0.79	0.41
Never/rarely disinterested	0.75	0.44	0.81	0.40
Never noisy (vs. rarely)	0.67	0.47	0.77	0.42
Never punished	0.78	0.41	0.80	0.40
Not absent past 2 weeks	0.36	0.48	0.33	0.47
Pupil's preferences†				
If no work becomes idle	0.62	0.49	0.52	0.50
Work preferred to leisure	0.68	0.47	0.60	0.49
Pupil's talent†				
No fear math class	0.08	0.28	0.09	0.29
Being popular in class	0.74	0.44	0.81	0.39
Want to study further	0.77	0.42	0.74	0.44
Social background‡				
Mother no education	0.16	0.36	0.18	0.39
Mother incomplete primary	0.23	0.42	0.24	0.43
Mother complete primary	0.19	0.39	0.21	0.41
Mother incomplete secondary	0.17	0.37	0.17	0.37
Mother complete secondary	0.14	0.34	0.12	0.32
Mother some tertiary	0.08	0.27	0.04	0.19
Mother education unknown	0.05	0.21	0.05	0.21
Father no education	0.13	0.34	0.17	0.37
Father incomplete primary	0.15	0.35	0.15	0.36
Father complete primary	0.12	0.32	0.12	0.33
Father incomplete secondary	0.17	0.38	0.17	0.38
Father complete secondary	0.16	0.37	0.16	0.37
Father some tertiary	0.19	0.39	0.14	0.35
Father education unknown	0.08	0.27	0.08	0.27
No news item	0.62	0.48	0.67	0.47
One news item	0.27	0.45	0.26	0.44
Two news items	0.11	0.31	0.08	0.27
Ownership of farming livestock	0.35	0.48	0.32	0.47

(*continued on next page*)

Table A5 (*continued*)

Mathematics	Secular schools n==5,907		Islamic schools n==2,042	
Variables	Mean	SD	Mean	SD
Parental effort‡				
House Tutor	0.31	0.46	0.21	0.41
Coaching centre	0.38	0.48	0.30	0.46
Parental help with homework	0.24	0.43	0.17	0.38
Demographic characteristics and religion				
Age	13.04	0.95	13.31	1.14
Non Muslim	0.09	0.29	0.01	0.09
Female	0.61	0.49	0.66	0.47
School characteristics				
School admits from any primary school	0.67	0.47	0.63	0.48
School has a library	0.57	0.50	0.59	0.49
School has a computer	0.55	0.50	0.44	0.50
Teacher behaviours				
Meet parents every 1 month	0.25	0.43	0.28	0.45
Meet parents every 3 months	0.20	0.40	0.12	0.32
Meet parents every 6 months	0.08	0.27	0.05	0.23
Meet parents if needed	0.47	0.50	0.54	0.50
At least 4 tests a year	0.26	0.44	0.30	0.46
Almost all pupils attend class	0.40	0.49	0.47	0.50
Average number of pupils assessed per school	44.64	26.19	23.83	13.46

‡Social background and parental effort are described in Table A2.
†Pupil's overall effort measures are described in Table A1.

Table A6
Correlation matrix of pupil's overall effort: school effort, preferences, and talent in Mathematics.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Pupil's school effort†											
(1) Nev/rarely perform low	1.00										
(2) Nev/rarely incomplete work	0.62	1.00									
(3) Nev/rarely lazy	0.37	0.49	1.00								
(4) Nev/rarely disinterested	0.45	0.52	0.51	1.00							
(5) Nev noisy (vs. rarely)	0.22	0.32	0.32	0.41	1.00						
(6) Nev punished	0.00	0.02	0.08	0.06	0.10	1.00					
(7) Not absent past 2 weeks	0.12	0.10	0.05	0.07	0.13	0.05	1.00				
Pupil's preferences†											
(8) If no work becomes idle	0.10	0.10	0.10	0.07	0.02	0.08	0.09	1.00			
(9) Work preferred to leisure	0.01	0.06	0.08	0.03	-0.03	0.05	0.00	0.54	1.00		
Pupil's talent†											
(10) No fear math class	0.12	0.11	0.11	0.12	0.06	0.09	0.06	0.13	0.12	1.00	
(11) Being popular in class	0.09	0.13	0.09	0.10	0.02	0.06	0.06	0.05	0.07	0.17	1.00
(12) Wants to study further	0.10	0.13	0.12	0.09	0.01	0.03	0.03	0.23	0.21	0.12	0.17

NB: Tetrachoric correlations are reported as recommended for binary variables.
†Pupil's overall effort measures are described in Table A1.

Table A7
Correlation matrix of pupil's overall effort: school effort, preferences, and talent in English.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Pupil's school effort†											
(1) Nev/rarely perform low	1.00										
(2) Nev/rarely incomplete work	0.57	1.00									
(3) Nev/rarely lazy	0.54	0.55	1.00								
(4) Nev/rarely disinterested	0.33	0.27	0.45	1.00							
(5) Nev noisy (vs. rarely)	-0.16	-0.10	-0.15	-0.20	1.00						
(6) Nev punished	0.01	0.03	0.02	0.03	0.02	1.00					
(7) Not absent past 2 weeks	0.08	0.10	0.02	0.06	-0.01	0.06	1.00				
Pupil's preferences†											
(8) If no work becomes idle	0.11	0.08	0.07	0.08	0.01	0.10	0.10	1.00			
(9) Work preferred to leisure	0.06	0.05	0.04	0.02	-0.03	0.07	0.01	0.54	1.00		
Pupil's talent†											
(10) No fear English class	0.11	0.12	0.10	0.04	-0.11	0.09	0.12	0.10	0.10	1.00	
(11) Being popular in class	0.08	0.08	0.10	0.08	-0.04	0.07	0.06	0.05	0.06	0.08	1.00
(12) Wants to study further	0.09	0.07	0.08	0.02	-0.05	0.03	0.03	0.23	0.19	0.13	0.16

NB: Tetrachoric correlations are reported as recommended for binary variables.
†Pupil's overall effort measures are described in Table A1.

Table A8
Correlation matrix of social background and parental efforts in mathematics.

Variables	(1)§	(2)§	(3)§§	(4)§§	(5)§§	(6)§§	(7)§§
Social background							
(1) Mother education	1.00						
(2) Father education	0.44	1.00					
(3) One news item	0.07	0.09	1.00				
(4) Two news items	0.09	0.08	-1.00	1.00			
(5) Ownership of farming livestock	0.08	0.07	-0.01	0.09	1.00		
Parental effort							
(6) House tutor	0.08	0.07	0.10	0.07	-0.05	1.00	
(7) Coaching centre	0.07	0.05	0.03	0.06	-0.07	-1.00	1.00
(8) Parental help with homework	0.08	0.06	0.08	0.02	0.07	0.12	-0.00

NB: §Spearman correlations reported; §§Tetrachoric correlations
‡Social background and parental effort are described in Table A2.

Table A9
Correlation matrix of social background and parental efforts in English.

Variables	(1)§	(2)§	(3)§§	(4)§§	(5)§§	(6)§§	(7)§§
Social background							
(1) Mother education	1.00						
(2) Father education	0.45	1.00					
(3) One news item	0.08	0.09	1.00				
(4) Two news items	0.08	0.09	-1.00	1.00			
(5) Ownership of farming livestock	0.09	0.08	-0.02	0.11	1.00		
Parental effort							
(6) House tutor	0.08	0.07	0.10	0.07	-0.05	1.00	
(7) Coaching centre	0.07	0.06	0.04	0.05	-0.08	-1.00	1.00
(8) Parental help with homework	0.08	0.08	0.07	0.06	0.07	0.11	0.00

NB: §Spearman correlations reported; §§Tetrachoric correlations
‡Social background and parental effort are described in Table A2.

Table A10
Baseline regression results – Mathematics sample.

	OLS		Multilevel Random-effect		OLS Fixed-effects		OLS Between-schools	
Variables	Coeff.	SE	Coeff.	SE	Coeff.	SE	Coeff.	SE
Pupil's overall effort†								
Pupil's school effort								
Never/rarely perform low	0.206**	0.090	0.326***	0.072	0.327***	0.073	0.989	0.692
Never/rarely incomplete work	-0.019	0.097	0.207***	0.073	0.217***	0.073	-1.613*	0.903
Never/rarely lazy	0.389***	0.102	0.250***	0.080	0.240***	0.080	0.513	0.904
Never/rarely disinterested	0.456***	0.102	0.237***	0.079	0.227***	0.079	1.665*	0.970
Never noisy (vs. rarely)	0.305***	0.089	0.456***	0.085	0.468***	0.086	-0.103	0.550
Never punished	0.519***	0.096	0.115	0.073	0.094	0.073	2.809***	0.898
Not absent past 2 weeks	0.292***	0.082	0.290***	0.065	0.282***	0.066	1.051	0.651
Pupil's preferences								
No work becomes idle	0.612***	0.086	0.372***	0.066	0.367***	0.067	0.194	0.833
Work preferred to leisure	0.131	0.088	-0.076	0.067	-0.085	0.067	0.706	0.910
Pupil's talent								
No fear math class	0.703***	0.141	0.297***	0.104	0.283***	0.105	1.920	1.447
Being popular in class	0.285***	0.092	0.239***	0.068	0.241***	0.068	0.137	1.015
Want to study further	0.451***	0.093	0.385***	0.070	0.385***	0.070	-0.373	0.908
Social background‡								
Mother incomplete primary	0.244*	0.131	0.127	0.095	0.120	0.095	2.136	1.690
Mother complete primary	0.394***	0.139	0.028	0.102	0.010	0.102	2.773*	1.678
Mother incomplete secondary	0.488***	0.147	0.115	0.107	0.099	0.107	3.725**	1.830
Mother complete secondary	0.620***	0.160	0.199*	0.116	0.179	0.117	2.658	2.052
Mother some tertiary	0.949***	0.198	0.341**	0.143	0.316**	0.143	7.471***	2.958
Mother education unknown	0.349	0.222	0.226	0.164	0.221	0.165	3.043	2.511
Father incomplete primary	0.043	0.150	0.022	0.107	0.018	0.107	-0.990	2.190
Father complete primary	0.183	0.160	0.129	0.115	0.122	0.115	0.706	2.237
Father incomplete secondary	0.104	0.148	0.106	0.107	0.109	0.107	-1.388	1.882
Father complete secondary	0.243	0.153	0.150	0.110	0.145	0.110	0.820	2.160
Father some tertiary	0.453***	0.159	0.268**	0.114	0.262**	0.115	2.064	2.261
Father education unknown	-0.101	0.186	-0.080	0.135	-0.078	0.136	-1.949	2.265
One news item	0.058	0.091	-0.011	0.070	-0.009	0.070	0.572	0.896

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Table A10 (*continued*)

Variables	OLS		Multilevel Random-effect		OLS Fixed-effects		OLS Between-schools	
	Coeff.	SE	Coeff.	SE	Coeff.	SE	Coeff.	SE
Two news items	0.260**	0.135	0.244**	0.106	0.251**	0.107	-1.172	1.075
Ownership of farming livestock	-0.042	0.083	0.050	0.063	0.058	0.063	-2.047***	0.815
Parental effort‡								
House Tutor	0.102	0.101	0.326***	0.079	0.339***	0.079	-1.725**	0.849
Coaching centre	0.227**	0.094	0.366***	0.074	0.378***	0.074	-1.685**	0.782
Parental help with homework	0.182*	0.096	-0.017	0.079	-0.022	0.080	0.464	0.707
Demographic characteristics and religion								
Age	0.857*	0.446	0.013	0.344	0.020	0.346	-1.094	4.329
Age^2	-0.031*	0.016	-0.004	0.012	-0.004	0.013	0.058	0.162
Non Muslim	-0.285*	0.152	-0.184*	0.113	-0.184	0.114	-1.212	1.441
Female	-1.260***	0.082	-1.288***	0.064	-1.285***	0.064	-1.431**	0.636
School characteristics								
School admits from any primary school	1.047***	0.086	0.780**	0.347			0.823**	0.375
Islamic school	-0.682***	0.094	-0.494	0.332			-0.790**	0.408
School has a library	-0.111	0.087	-0.253	0.334			-0.288	0.369
School has a computer	0.475***	0.084	0.850***	0.333			0.785**	0.344
Teacher behaviour								
Meet parents every 1 month	-0.091	0.097	-0.353	0.374			-0.343	0.382
Meet parents every 3 months	0.238**	0.112	0.385	0.463			0.438	0.493
Meet parents every 6 months	-0.477***	0.159	-0.871	0.624			-1.115*	0.638
At least 4 tests a year	0.137	0.092	-0.463	0.362			-0.600	0.376
Almost all pupils attend class	0.828***	0.083	0.756**	0.323			0.618*	0.339
Constant	-2.876	3.060	5.005**	2.418	6.208***	2.401	4.529	28.82
sigma_u			2.668	0.112	2.865	0.125		
sigma_e			2.398	0.019	2.403	0.020		
rho			0.553	0.021	0.587	0.023		
Number of obs	7949		7949		7949		311	
Number of groups			311		311			

*** 1%; **5%; *10%.
†Pupil's overall effort measures are described in Table A1.
‡Social background and parental effort are described in Table A2.

Table A11

Baseline regression results – English sample.

Variables	OLS		Multilevel OLS		OLS Fixed-effects		Between-schools Random-effect	
	Coeff.	SE	Coeff.	SE	Coeff.	SE	Coeff.	SE
Pupil's overall effort†								
Pupil's school effort								
Never/rarely perform low	0.695***	0.095	0.651***	0.080	0.643***	0.081	0.887	0.792
Never/rarely incomplete work	0.420***	0.095	0.394***	0.080	0.393***	0.081	0.158	0.912
Never/rarely lazy	0.459***	0.101	0.623***	0.084	0.633***	0.085	0.001	0.995
Never/rarely disinterested	0.578***	0.090	0.274***	0.091	0.257***	0.093	0.819	0.519
Never noisy (vs. rarely)	-0.101	0.097	-0.224***	0.089	-0.229***	0.090	-0.276	0.652
Never punished	0.543***	0.097	0.282***	0.082	0.255***	0.082	2.694***	0.840
Not absent past 2 weeks	0.398***	0.083	0.338***	0.074	0.323***	0.075	0.717	0.609
Pupil's preferences								
If no work becomes idle	0.554***	0.087	0.554***	0.074	0.549***	0.075	0.211	0.765
Work preferred to leisure	0.192**	0.090	0.017	0.075	0.004	0.075	0.756	0.840
Pupil's talent								
Fear English class	-0.688***	0.141	-0.599***	0.115	-0.599***	0.116	-0.220	1.481
Being popular in class	0.510***	0.092	0.436***	0.076	0.436***	0.076	0.345	0.919
Want to study further	0.597***	0.094	0.512***	0.078	0.504***	0.079	1.129	0.843
Social background‡								
Mother incomplete primary	0.162	0.131	0.038	0.106	0.036	0.106	0.023	1.562
Mother complete primary	0.353***	0.140	0.176	0.114	0.176	0.115	-0.234	1.532
Mother incomplete secondary	0.554***	0.147	0.332***	0.119	0.326***	0.120	1.970	1.718
Mother complete secondary	0.667***	0.161	0.427***	0.130	0.419***	0.131	1.257	1.874
Mother some tertiary	0.738***	0.199	0.276*	0.160	0.255	0.161	5.555**	2.754
Mother education unknown	0.121	0.221	-0.238	0.183	-0.281	0.184	3.949*	2.278
Father incomplete primary	0.207	0.150	0.216*	0.120	0.213*	0.120	-0.060	2.053
Father complete primary	0.150	0.161	0.098	0.129	0.089	0.129	2.085	2.038
Father incomplete secondary	0.198	0.149	0.236**	0.119	0.233**	0.120	0.209	1.790
Father complete secondary	0.274*	0.154	0.373***	0.123	0.375***	0.123	-1.529	1.976
Father some tertiary	0.667***	0.160	0.603***	0.129	0.590***	0.129	1.574	1.967
Father education unknown	0.182	0.188	0.194	0.153	0.186	0.154	-1.035	2.073
One news item	0.024	0.092	0.009	0.079	0.002	0.079	-0.017	0.849

Table A11 (*continued*)

Variables	OLS		Multilevel OLS		OLS Fixed-effects		Between-schools Random-effect	
	Coeff.	SE	Coeff.	SE	Coeff.	SE	Coeff.	SE
Two news items	0.354***	0.135	-0.095	0.118	-0.141	0.120	2.563***	0.987
Ownership of farming livestock	0.146*	0.084	0.245***	0.071	0.253***	0.071	-1.227	0.766
Parental effort‡								
House Tutor	0.015	0.101	0.223***	0.088	0.227***	0.089	-0.534	0.784
Coaching centre	0.342***	0.095	0.408***	0.083	0.412***	0.084	-0.351	0.736
Parental help with homework	0.205**	0.097	0.125	0.089	0.123	0.090	0.316	0.642
Demographic characteristics and religion								
Age	-0.784*	0.473	-0.783***	0.406	-0.789**	0.410	-0.603	3.910
Age^2	0.024	0.017	0.022	0.015	0.022	0.015	0.030	0.145
Non Muslim	-0.313**	0.153	-0.265**	0.127	-0.254**	0.128	-2.081	1.304
Female	-0.345***	0.083	-0.209***	0.071	-0.189***	0.072	-1.133*	0.594
School characteristics								
School admits from any primary school	-0.506***	0.086	-0.333	0.313			-0.490	0.345
Islamic school	-1.929***	0.096	-1.587***	0.300			-1.542***	0.379
School has a library	0.195**	0.086	-0.101	0.299			-0.411	0.342
School has a computer	0.423***	0.084	0.679**	0.297			0.660**	0.312
Teacher behaviours								
Meet parents every 1 month	0.163*	0.099	0.014	0.348			0.283	0.374
Meet parents every 3 months	1.040***	0.116	1.027**	0.429			0.965**	0.453
Meet parents every 6 months	0.073	0.139	0.013	0.504			0.056	0.528
At least 4 tests a year	1.013***	0.120	1.294***	0.434			0.989**	0.456
Almost all pupils attend class	0.717***	0.081	0.598**	0.288			0.716**	0.315
Constant	8.154***	3.236	8.926***	2.853	10.29	2.825	3.412	26.47
sigma_u			2.368	0.104	2.736	0.181		
sigma_e			2.700	0.022	2.705	0.038		
rho			0.435	0.022	0.506	0.039		
Number of obs	7923		7923		7923		311	
Number of groups			311		311			

*** 1%; **5%; *10%.
†Pupil's overall effort measures are described in Table A1.
‡Social background and parental effort are described in Table A2.

Table A12
Baseline regressions with school averages results – mathematics and English.

Variables	Mathematics		English	
	Multilevel random-effect		Multilevel random-effect	
	Coeff.	SE	Coeff.	SE
Pupil's overall effort†				
Pupil's school effort				
Never/rarely perform low	0.326***	0.073	0.643***	0.081
Never/rarely incomplete work	0.218***	0.073	0.393***	0.080
Never/rarely lazy	0.240***	0.080	0.633***	0.085
Never/rarely disinterested	0.226***	0.079	0.256***	0.092
Never noisy (vs. rarely)	0.468***	0.086	-0.229***	0.090
Never punished	0.093	0.073	0.255***	0.082
Not absent past 2 weeks	0.282***	0.066	0.323***	0.074
Pupil's preferences				
If no work becomes idle	0.367***	0.067	0.549***	0.075
Work preferred to leisure	-0.085	0.067	0.004	0.075
Pupil's talent				
Fear math class	0.283***	0.104	-0.598***	0.115
Being popular in class	0.241***	0.068	0.436***	0.076
Want to study further	0.385***	0.070	0.504***	0.079
Social background‡				
Mother incomplete primary	0.121	0.095	0.036	0.106
Mother complete primary	0.010	0.102	0.176	0.115
Mother incomplete secondary	0.099	0.107	0.326***	0.119
Mother complete secondary	0.179	0.116	0.419***	0.131
Mother some tertiary	0.317**	0.143	0.255	0.161
Mother education unknown	0.222	0.165	-0.281	0.184
Father incomplete primary	0.019	0.107	0.214*	0.120
Father complete primary	0.122	0.115	0.090	0.129
Father incomplete secondary	0.109	0.107	0.234**	0.120
Father complete secondary	0.146	0.110	0.376***	0.123
Father some tertiary	0.262**	0.115	0.591***	0.129
Father education unknown	-0.077	0.136	0.186	0.154

(*continued on next page*)

Table A12 (*continued*)

Variables	Mathematics		English	
	Multilevel random-effect		Multilevel random-effect	
	Coeff.	SE	Coeff.	SE
One news item	−0.010	0.070	0.002	0.079
Two news items	0.251**	0.107	−0.142	0.119
Ownership of farming livestock	0.058	0.063	0.252***	0.071
Parental effort‡				
House Tutor	0.339***	0.079	0.227***	0.089
Coaching centre	0.379***	0.074	0.412***	0.083
Parental help with homework	−0.022	0.080	0.124	0.090
Demographic characteristics and religion				
Age	−0.789*	0.409	−1.079***	0.409
Age^2	0.022	0.015	0.029*	0.015
Non Muslim	−0.252**	0.128	−0.297***	0.128
Female	−0.189***	0.072	−0.179***	0.071
School characteristics				
School admits from any primary school	0.809**	0.378	−1.633***	0.349
Islamic school	0.927**	0.418	−1.907***	0.656
School has a library	−0.275	0.342	−0.355	0.312
School has a computer	0.769**	0.318	0.639**	0.285
Teacher behaviours				
Meet parents every 1 month	−0.334	0.353	0.289	0.340
Meet parents every 3 months	0.443	0.454	0.968***	0.412
Meet parents every 6 months	−1.096*	0.593	0.033	0.485
Meet parents if needed	0.635**	0.313	0.730***	0.287
At least 4 tests a year	−0.585*	0.348	0.988**	0.416
Almost all pupils attend class	0.836	0.346	−0.508	0.314
Average pupil's school effort at school-level				
Never/rarely perform low	0.634	0.649	0.266	0.742
Never/rarely incomplete work	−1.855**	0.849	−0.255	0.842
Never/rarely lazy	0.318	0.845	−0.655	0.922
Never/rarely disinterested	1.412	0.906	0.568	0.484
Never noisy (vs. rarely)	−0.553	0.514	0.004	0.606
Never punished	2.735***	0.839	2.422***	0.779
Not absent past 2 weeks	0.782	0.607	0.375	0.563
Average pupil's preferences at school-level				
If no work becomes idle	−0.171	0.778	−0.311	0.708
Work preferred to leisure	0.825	0.853	0.766	0.780
Average pupil's talent at school-level				
Fear math class	1.746	1.357	0.181	1.378
Being popular in class	−0.081	0.946	0.025	0.848
Want to study further	−0.803	0.853	0.538	0.790
Average social background at school-level				
Mother incomplete primary	1.897	1.583	0.181	1.454
Mother complete primary	2.784*	1.572	−0.134	1.431
Mother incomplete secondary	3.570**	1.711	1.857	1.592
Mother complete secondary	2.531	1.927	1.186	1.748
Mother some tertiary	7.064***	2.765	5.639*	2.555
Mother education unknown	2.733	2.344	4.115*	2.113
Father incomplete primary	−0.912	2.050	−0.347	1.907
Father complete primary	0.573	2.099	1.755	1.907
Father incomplete secondary	−1.376	1.767	−0.190	1.670
Father complete secondary	0.882	2.025	−1.862	1.842
Father some tertiary	1.876	2.126	0.631	1.850
Father education unknown	−1.798	2.122	−1.326	1.931
One news item	0.637	0.839	−0.023	0.786
Two news items	−1.362	1.010	2.631***	0.923
Ownership of farming livestock	−2.167***	0.768	−1.538**	0.719
Average parental effort at school-level				
House Tutor	−2.092***	0.792	−0.891	0.728
Coaching centre	−2.049***	0.731	−0.865	0.684
Parental help with homework	0.507	0.662	0.254	0.598
Average demographic characteristics and religion at school-level				
Age	−1.017	4.037	0.182	3.615
Age^2	0.059	0.152	0.008	0.134
Non Muslim	−1.062	1.359	−1.725	1.238
Female	−0.157	0.595	−0.954	0.554
Constant	3.602	26.78	3.507*	24.30
sigma_u	2.411	0.103	2.162	0.096
sigma_e	2.398	0.019	2.700	0.022
rho	0.503	0.022	0.391	0.022
Number of obs	7949		7923	
Number of groups	311		311	

*** 1%; **5%; *10%.

†Pupil's overall effort measures are described in Table A1.

‡Social background and parental effort are described in Table A2.

Table A13
Roemer auxiliary regression – Mathematics sample.

Variables	Never/rarely perform low		Never/rarely incomplete work		Never/rarely lazy		Never/rarely disinterested		Never noisy (vs. rarely)		Never punished	
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
Social background‡												
Mother incomplete primary	0.220**	0.097	0.062	0.095	0.093	0.106	0.177*	0.106	0.092	0.117	0.350***	0.100
Mother complete primary	0.140	0.104	0.089	0.103	0.011	0.117	0.217*	0.115	0.264**	0.127	0.306***	0.110
Mother incomplete secondary	0.246**	0.110	0.102	0.108	0.211*	0.121	0.180	0.121	0.184	0.132	0.260**	0.114
Mother complete secondary	-0.006	0.119	-0.009	0.118	0.220*	0.132	0.029	0.129	0.198	0.145	0.213*	0.124
Mother some tertiary	0.335**	0.151	0.209	0.153	0.198	0.165	0.187	0.164	0.116	0.178	0.307***	0.155
Mother education unknown	-0.066	0.168	-0.047	0.169	0.216	0.191	0.369*	0.192	0.248	0.210	0.351**	0.177
Father incomplete primary	0.040	0.110	0.164	0.107	0.033	0.120	0.112	0.121	0.196	0.135	-0.152	0.116
Father complete primary	0.116	0.117	0.151	0.115	0.179	0.133	0.044	0.130	0.112	0.144	-0.163	0.125
Father incomplete secondary	0.254**	0.109	0.180*	0.106	0.181	0.120	0.161	0.121	0.044	0.134	-0.087	0.116
Father complete secondary	0.209*	0.111	0.131	0.110	0.075	0.124	0.203	0.125	0.291**	0.138	-0.077	0.119
Father some tertiary	0.377***	0.117	0.357***	0.117	0.307**	0.130	0.230*	0.129	0.425***	0.143	-0.018	0.125
Father education unknown	-0.036	0.137	0.018	0.135	-0.123	0.151	-0.099	0.152	0.029	0.173	0.216	0.152
One news item	0.046	0.072	-0.003	0.072	0.174**	0.081	0.024	0.080	-0.071	0.090	-0.029	0.077
Two news items	0.133	0.110	0.289***	0.114	0.375***	0.125	0.206*	0.124	0.117	0.132	-0.107	0.113
Ownership of farming livestock	-0.033	0.064	0.037	0.065	0.036	0.073	0.223***	0.072	0.140*	0.079	-0.087	0.069
Parental effort‡												
House Tutor	0.229***	0.081	0.238***	0.081	0.308***	0.092	0.195**	0.091	0.149	0.101	-0.147*	0.084
Coaching centre	0.276***	0.075	0.271***	0.075	0.305***	0.086	0.211***	0.083	0.226**	0.093	0.060	0.080
Parental help with homework	0.141*	0.083	0.153*	0.081	0.033	0.090	0.015	0.090	0.201**	0.101	0.150*	0.087
Demographic characteristics and religion												
Age	-0.852**	0.350	-0.346	0.339	-0.174	0.381	-0.282	0.400	0.356	0.434	-0.106	0.357
Age^2	0.025**	0.013	0.007	0.012	0.002	0.014	0.007	0.015	-0.016	0.016	0.000	0.013
Non Muslim	-0.141	0.115	0.126	0.118	-0.029	0.132	0.086	0.138	-0.041	0.143	-0.037	0.123
Female	-0.023	0.065	-0.089	0.065	-0.087	0.075	0.058	0.073	0.074	0.081	0.600***	0.069
Number of obs	6,909		6,833		6,065		6,094		5,223		7,376	
Number of groups	253		252		219		207		167		261	

NB: Each pupil's effort, preferences and talent variables are considered as the independent variables in Probit models with school fixed effects
‡Social background and parental effort are described in Table A2.
*** 1%; **5%; *10%

Table A14
Roemer auxiliary regression results – Mathematics sample.

Variables	Not absent past 2 weeks		If no work becomes idle		Work preferred to leisure		No fear math class		Being popular in class		Want to study further	
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
Social background‡												
Mother incomplete primary	0.080	0.093	0.118	0.088	0.046	0.088	0.140	0.137	0.306***	0.093	0.016	0.095
Mother complete primary	0.043	0.102	0.194**	0.096	0.098	0.097	0.376**	0.159	0.301***	0.102	0.026	0.105
Mother incomplete secondary	0.060	0.105	0.158	0.101	0.159	0.102	0.030	0.162	0.181*	0.107	0.077	0.111
Mother complete secondary	0.115	0.114	0.118	0.109	0.079	0.110	0.123	0.180	0.212*	0.116	-0.114	0.118
Mother some tertiary	0.124	0.138	0.187	0.134	0.149	0.136	0.036	0.226	0.158	0.142	-0.093	0.148
Mother education unknown	-0.021	0.158	-0.011	0.152	-0.076	0.154	-0.096	0.236	-0.108	0.161	-0.206	0.165
Father incomplete primary	0.202*	0.107	0.058	0.101	0.133	0.102	0.185	0.153	0.062	0.106	0.101	0.108
Father complete primary	0.057	0.119	-0.023	0.109	0.060	0.110	0.068	0.166	-0.040	0.115	0.058	0.117
Father incomplete secondary	0.200*	0.106	-0.022	0.100	-0.006	0.101	0.642***	0.167	0.029	0.106	0.151	0.108
Father complete secondary	0.312***	0.110	0.019	0.103	-0.112	0.103	0.384**	0.164	0.318***	0.112	0.151	0.111
Father some tertiary	0.323***	0.113	0.129	0.108	0.055	0.109	0.456***	0.179	0.195*	0.115	0.346***	0.119
Father education unknown	0.302**	0.132	-0.052	0.126	-0.055	0.129	0.165	0.200	0.045	0.136	0.157	0.137
One news item	0.200***	0.068	0.070	0.066	0.011	0.066	0.205*	0.111	-0.025	0.071	0.107	0.071
Two news items	0.138	0.100	0.113	0.096	0.142	0.097	0.101	0.161	0.206*	0.108	0.364***	0.110
Ownership of farming livestock	0.189***	0.063	0.091	0.061	0.097	0.062	-0.084	0.099	-0.041	0.065	0.146**	0.067
Parental effort‡												
House Tutor	0.019	0.078	-0.004	0.074	-0.092	0.075	0.067	0.118	0.088	0.079	0.065	0.081
Coaching centre	0.103	0.073	-0.060	0.070	-0.090	0.071	0.222**	0.114	0.343***	0.075	0.090	0.076
Parental help with homework	0.115	0.077	0.359***	0.074	0.117	0.075	0.457***	0.138	0.258***	0.082	-0.032	0.080
Demographic characteristics and religion												
Age	-0.631**	0.327	-0.306	0.314	0.682**	0.336	-0.555	0.498	-0.109	0.354	-1.096***	0.387
Age^2	0.021*	0.012	0.010	0.011	-0.026**	0.012	0.014	0.018	0.003	0.013	0.036***	0.014
Non Muslim	0.015	0.110	-0.192*	0.106	0.027	0.109	-0.235	0.176	-0.103	0.112	-0.028	0.120
Female	0.202***	0.063	0.155***	0.061	0.193***	0.061	-0.019	0.105	-0.060	0.066	-0.017	0.067
Number of obs	7,324		7,333		7,215		5,615		7,643		7,256	
Number of groups	276		277		273		202		277		269	

NB: Each pupil's effort, preferences and talent variables are considered as the independent variables in Probit models with school fixed effects
‡Social background and parental effort are described in Table A2.
*** 1%; **5%; *10%

Table A15
Roemer auxiliary regression results – English sample

Variables	Never/rarely perform low		Never/rarely incomplete work		Never/rarely lazy		Never/rarely disinterested		Never noisy (vs. rarely)		Never punished	
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
Social background‡												
Mother incomplete primary	0.180*	0.094	0.229***	0.093	0.146	0.098	0.170	0.115	0.036	0.111	0.348***	0.100
Mother complete primary	0.118	0.102	0.151	0.101	-0.037	0.106	0.057	0.122	0.051	0.120	0.320***	0.111
Mother incomplete secondary	0.074	0.107	0.074	0.105	0.090	0.112	0.137	0.128	-0.137	0.128	0.251**	0.114
Mother complete secondary	-0.016	0.117	0.056	0.116	-0.103	0.122	-0.057	0.139	-0.013	0.139	0.192	0.125
Mother some tertiary	0.099	0.149	0.108	0.147	0.092	0.154	0.081	0.173	0.062	0.171	0.355**	0.157
Mother education unknown	-0.004	0.162	0.046	0.168	-0.006	0.176	0.026	0.192	-0.038	0.202	0.265	0.173
Father incomplete primary	0.041	0.105	0.025	0.105	-0.007	0.111	-0.217*	0.129	-0.284	0.127	-0.098	0.116
Father complete primary	0.181	0.114	0.179	0.115	0.196*	0.120	0.112	0.140	-0.340***	0.138	-0.163	0.125
Father incomplete secondary	0.206**	0.105	0.250**	0.106	0.158	0.111	-0.016	0.128	-0.158	0.124	-0.085	0.116
Father complete secondary	0.341***	0.109	0.216**	0.108	0.169	0.115	-0.098	0.131	-0.155	0.128	-0.031	0.120
Father some tertiary	0.387***	0.115	0.456***	0.115	0.396***	0.121	0.214	0.136	-0.064	0.133	-0.017	0.126
Father education unknown	0.175	0.137	0.233*	0.139	0.110	0.145	0.052	0.166	-0.068	0.161	0.095	0.151
One news item	0.063	0.072	0.139**	0.072	0.196***	0.076	0.140*	0.085	-0.044	0.084	-0.054	0.077
Two news items	0.116	0.108	0.077	0.107	0.329***	0.115	0.021	0.128	-0.241*	0.130	-0.158	0.113
Ownership of farming livestock	-0.020	0.064	0.095	0.064	0.063	0.068	0.203***	0.074	-0.070	0.075	-0.058	0.070
Parental effort‡												
House Tutor	0.142*	0.080	0.149*	0.080	0.178**	0.085	0.174*	0.095	0.061	0.092	-0.128	0.084
Coaching centre	0.320***	0.075	0.150**	0.074	0.195***	0.079	0.130	0.088	-0.190**	0.088	0.056	0.081
Parental help with homework	0.208***	0.082	0.067	0.082	-0.027	0.084	0.040	0.096	-0.057	0.097	0.124	0.087
Demographic characteristics and religion												
Age	-0.670*	0.395	0.171	0.380	-0.145	0.463	-0.783	0.558	-1.144***	0.410	-0.566	0.403
Age²	0.020	0.014	-0.011	0.014	0.000	0.017	0.024	0.021	0.041***	0.015	0.018	0.015
Non Muslim	0.018	0.116	0.074	0.119	0.003	0.125	0.030	0.137	-0.053	0.138	-0.061	0.125
Female	0.035	0.065	0.099	0.065	-0.043	0.068	-0.190***	0.077	0.063	0.078	0.611***	0.069
Number of obs	7,089		6,967		6,517		5,323		5,941		7,336	
Number of groups	267		258		231		175		214		265	

NB: Each pupil's effort, preferences and talent variables are considered as the independent variables in Probit models with school fixed effects
‡Social background and parental effort are described in Table A2.
*** 1%; **5%; *10%

Table A16
Roemer auxiliary regression results – English sample

Variables	Not absent past 2 weeks		If no work becomes idle		Work preferred to leisure		No fear English class		Being popular in class		Want to study further	
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
Social background‡												
Mother incomplete primary	0.076	0.093	0.058	0.087	0.002	0.088	-0.180	0.134	0.268***	0.092	0.013	0.094
Mother complete primary	0.063	0.103	0.138	0.096	0.026	0.097	-0.320**	0.155	0.262***	0.102	-0.011	0.105
Mother incomplete secondary	0.064	0.105	0.138	0.100	0.156	0.102	-0.253	0.161	0.152	0.106	0.109	0.111
Mother complete secondary	0.106	0.114	0.075	0.109	0.033	0.110	-0.316*	0.180	0.190	0.116	-0.074	0.118
Mother some tertiary	0.098	0.139	0.192	0.134	0.113	0.137	-0.037	0.217	0.142	0.141	-0.095	0.149
Mother education unknown	0.013	0.159	-0.036	0.151	-0.172	0.153	-0.052	0.232	-0.055	0.160	-0.129	0.165
Father incomplete primary	0.166	0.107	0.092	0.100	0.096	0.101	-0.040	0.154	0.056	0.106	0.113	0.107
Father complete primary	-0.022	0.119	0.030	0.109	0.076	0.110	-0.146	0.173	-0.058	0.115	0.069	0.117
Father incomplete secondary	0.164	0.107	0.000	0.100	0.029	0.101	-0.210	0.159	-0.013	0.105	0.122	0.108
Father complete secondary	0.231**	0.110	0.039	0.103	-0.090	0.103	-0.314*	0.167	0.265**	0.111	0.159	0.111
Father some tertiary	0.317***	0.114	0.085	0.108	0.067	0.109	-0.282	0.177	0.143	0.115	0.328***	0.119
Father education unknown	0.274**	0.134	-0.110	0.127	-0.039	0.130	0.053	0.200	-0.053	0.136	0.161	0.138
One news item	0.194***	0.069	0.067	0.066	-0.020	0.066	-0.125	0.107	0.011	0.070	0.095	0.071
Two news items	0.225**	0.100	0.070	0.097	0.108	0.098	-0.032	0.150	0.184*	0.107	0.388***	0.110
Ownership of farming livestock	0.201***	0.064	0.105*	0.061	0.075	0.062	0.012	0.099	-0.040	0.065	0.110*	0.067
Parental effort‡												
House Tutor	0.011	0.078	0.016	0.074	-0.056	0.075	0.658	0.479	-0.089	0.363	-1.406***	0.439
Coaching centre	0.134*	0.073	0.003	0.070	-0.023	0.071	-0.017	0.017	0.002	0.013	0.048***	0.016
Parental help with homework	0.108	0.077	0.376***	0.074	0.116	0.075	0.229	0.169	-0.094	0.112	-0.003	0.120
Demographic characteristics and religion												
Age	-0.710**	0.352	-0.435	0.336	0.595*	0.356	-0.024	0.101	-0.052	0.065	-0.020	0.066
Age²	0.025**	0.013	0.014	0.012	-0.022*	0.013	-0.109	0.118	0.072	0.078	0.053	0.081
Non Muslim	0.057	0.111	-0.201*	0.106	0.040	0.109	-0.190*	0.111	0.303***	0.075	0.091	0.076
Female	0.225***	0.064	-0.162***	0.061	0.183	0.061	-0.052	0.122	0.264***	0.082	-0.020	0.081

Table A16 (*continued*)

Variables	Not absent past 2 weeks		If no work becomes idle		Work preferred to leisure		No fear English class		Being popular in class		Want to study further	
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
Number of obs	7,232		7,353		7,134		5,473		7,578		7,237	
Number of groups	275		280		274		198		279		275	

NB: Each pupil's effort, preferences and talent variables are considered as the independent variables in Probit models with school fixed effects
‡Social background and parental effort are described in Table A2.
*** 1%; **5%; *10%

Table A17
Roemer regression results – Mathematics sample.

Variables	OLS		Multilevel Random-effect		OLS Fixed-effects		OLS Between-schools	
	Coeff.	SE	Coeff.	SE	Coeff.	SE	Coeff.	SE
Pupil's overall effort†								
Pupil's school effort								
Never/rarely perform low	0.030**	0.019	0.047***	0.011	0.047***	0.011	0.166	0.156
Never/rarely incomplete work	-0.002	0.053	0.068***	0.023	0.072***	0.023	0.159	0.512
Never/rarely lazy	0.189***	0.049	0.118***	0.039	0.109***	0.039	-0.052	0.478
Never/rarely disinterested	0.196***	0.015	0.102***	0.033	0.098***	0.033	0.132	0.085
Never noisy (vs. rarely)	0.112***	0.012	0.160***	0.030	0.161***	0.030	-0.034	0.079
Never punished	0.220***	0.023	0.050	0.034	0.043	0.033	0.634***	0.207
Not absent past 2 weeks	0.068***	0.018	0.067***	0.015	0.063***	0.015	0.148	0.131
Pupil's preferences								
If no work becomes idle	0.244***	0.025	0.148***	0.027	0.151***	0.026	0.095	0.223
Work preferred to leisure	0.028	0.021	-0.016	0.014	-0.016	0.014	0.143	0.193
Pupil's talent								
Fear math class	0.149***	0.026	0.064***	0.023	0.061***	0.023	-0.019	0.273
Being popular in class	0.173***	0.056	0.144***	0.041	0.139***	0.041	0.252	0.560
Want to study further	0.057***	0.009	0.048***	0.009	0.047***	0.009	0.111	0.085
Social background‡								
Mother incomplete primary	0.413***	0.131	0.222**	0.095	0.200**	0.094	0.255	1.569
Mother complete primary	0.602***	0.140	0.146	0.102	0.116	0.102	0.008	1.536
Mother incomplete secondary	0.644***	0.146	0.214**	0.107	0.178*	0.106	2.081	1.723
Mother complete secondary	0.747***	0.161	0.273**	0.116	0.251**	0.116	1.383	1.886
Mother some tertiary	1.112***	0.199	0.444***	0.143	0.410***	0.142	5.789**	2.768
Mother education unknown	0.450**	0.222	0.268*	0.165	0.242	0.164	4.031*	2.286
Father incomplete primary	0.088	0.150	0.070	0.107	0.055	0.106	-0.024	2.060
Father complete primary	0.194	0.162	0.155	0.115	0.141	0.114	2.048	2.044
Father incomplete secondary	0.236	0.149	0.192*	0.107	0.197*	0.106	0.260	1.796
Father complete secondary	0.380***	0.154	0.260**	0.110	0.254**	0.109	-1.430	1.981
Father some tertiary	0.670***	0.160	0.434***	0.115	0.426***	0.114	1.755	1.972
Father education unknown	-0.061	0.188	-0.064	0.135	-0.065	0.135	-0.944	2.088
One news item	0.124	0.092	0.026	0.070	0.025	0.070	-0.007	0.850
Two news items	0.405***	0.135	0.361***	0.106	0.354***	0.106	2.568***	0.983
Ownership of farming livestock	-0.009	0.084	0.082	0.063	0.099	0.063	-1.220	0.768
Parental effort‡								
House Tutor	0.179*	0.101	0.400***	0.079	0.410***	0.079	-0.557	0.788
Coaching centre	0.385***	0.096	0.487***	0.074	0.505***	0.074	-0.194	0.756
Parental help with homework	0.365***	0.097	0.098	0.079	0.105	0.079	0.490	0.664
Demographic characteristics and religion								
Age	0.577	0.473	-0.194	0.344	-0.219	0.345	-1.231	3.952
Age²	-0.023	0.017	0.002	0.012	0.003	0.013	0.050	0.146
Non Muslim	-0.355**	0.153	-0.222**	0.113	-0.221**	0.112	-2.135	1.312
Female	-1.189***	0.082	-1.287***	0.064	-1.308***	0.064	0.841	0.597
School characteristics								
School admits from any primary school	1.051***	0.086	0.782**	0.347			-0.481	0.346
Islamic school	-0.685***	0.096	-0.493	0.332			1.542***	0.381
School has a library	-0.108	0.086	-0.252	0.334			-0.402	0.343
School has a computer	0.473***	0.084	0.849***	0.333			0.662**	0.314
Teacher behaviours								
Meet parents every 1 month	-0.091	0.099	-0.353	0.374			0.267	0.375
Meet parents every 3 months	0.236**	0.117	0.384	0.463			0.966**	0.455
Meet parents every 6 months	-0.486***	0.139	-0.872	0.624			0.036	0.531
At least 4 tests a year	0.144	0.120	-0.461	0.362			0.993**	0.457
Almost all pupils attend class	0.827***	0.081	0.755**	0.323			0.708**	0.317
Constant	-0.057	3.231	7.040***	2.411	8.499***	2.386	8.752	26.56

Table A17 (*continued*)

Variables	OLS Coeff.	OLS SE	Multilevel Random-effect Coeff.	Multilevel Random-effect SE	OLS Fixed-effects Coeff.	OLS Fixed-effects SE	OLS Between-schools Coeff.	OLS Between-schools SE
sigma_u			2.668	0.112	2.211	0.194		
sigma_e			2.399	0.019	2.665	0.036		
rho			0.553	0.021	0.408	0.043		
Number of obs	7949		7949		7949		311	
Number of groups			311		311			

*** 1%; **5%; *10%.
NB: Generalised residuals of auxiliary equations are substituted to observed effort, preferences and talent.
†Pupil's overall effort measures are described in Table A1.
‡Social background and parental effort are described in Table A2.

Table A18
Roemer regression results – English sample.

Variables	OLS Coeff.	OLS SE	Multilevel Random-effect Coeff.	Multilevel Random-effect SE	OLS Fixed-effects Coeff.	OLS Fixed-effects SE	OLS Between-schools Coeff.	OLS Between-schools SE
Pupil's overall effort†								
Pupil's school effort								
Never/rarely perform low	0.136***	0.019	0.128***	0.016	0.127***	0.016	0.550	0.477
Never/rarely incomplete work	0.247***	0.053	0.229***	0.045	0.228***	0.045	0.135	0.549
Never/rarely lazy	0.213***	0.049	0.295***	0.041	0.300***	0.041	-0.066	0.585
Never/rarely disinterested	0.094***	0.015	0.044***	0.015	0.041***	0.015	0.479	0.313
Never noisy (vs. rarely)	-0.012	0.012	-0.027***	0.011	-0.027***	0.011	-0.116	0.377
Never punished	0.124***	0.023	0.067***	0.020	0.060***	0.020	1.577***	0.479
Not absent past 2 weeks	0.085***	0.018	0.071***	0.016	0.068***	0.016	0.409	0.372
Pupil's preferences								
If no work becomes idle	0.160***	0.025	0.160***	0.022	0.159***	0.022	0.172	0.473
Work preferred to leisure	0.046**	0.021	0.005	0.017	0.002	0.017	0.388	0.512
Pupil's talent								
Fear English class	-0.128***	0.026	-0.112***	0.021	-0.112***	0.021	-0.034	0.755
Being popular in class	0.312***	0.056	0.266***	0.046	0.265***	0.046	0.233	0.538
Want to study further	0.060***	0.009	0.051***	0.008	0.051***	0.008	0.656	0.496
Social background								
Mother incomplete primary	0.352***	0.131	0.201*	0.106	0.197*	0.106	0.264	1.558
Mother complete primary	0.517***	0.140	0.305***	0.114	0.303***	0.115	0.100	1.518
Mother incomplete secondary	0.697***	0.146	0.452***	0.119	0.444***	0.120	2.200	1.716
Mother complete secondary	0.753***	0.161	0.490***	0.130	0.480***	0.131	1.402	1.868
Mother some tertiary	0.869***	0.199	0.384**	0.160	0.361**	0.161	5.884**	2.757
Mother education unknown	0.130	0.222	-0.238	0.183	-0.281	0.184	3.997*	2.276
Father incomplete primary	0.225	0.150	0.239**	0.120	0.237**	0.120	0.102	2.045
Father complete primary	0.219	0.162	0.178	0.129	0.170	0.129	2.168	2.036
Father incomplete secondary	0.293**	0.149	0.337***	0.119	0.334***	0.120	0.316	1.789
Father complete secondary	0.456***	0.154	0.551***	0.123	0.553***	0.124	-1.479	1.973
Father some tertiary	0.926***	0.160	0.856***	0.129	0.844***	0.129	1.886	1.957
Father education unknown	0.246	0.188	0.254*	0.153	0.246	0.154	-0.863	2.076
One news item	0.114	0.092	0.102	0.079	0.095	0.079	-0.009	0.847
Two news items	0.492***	0.135	0.051	0.118	0.005	0.120	2.603***	0.975
Ownership of farming livestock	0.184**	0.084	0.282***	0.071	0.289***	0.071	-1.194	0.766
Parental effort								
House Tutor	0.103	0.101	0.315***	0.088	0.320***	0.089	-0.446	0.779
Coaching centre	0.527***	0.096	0.581***	0.083	0.584***	0.084	-0.138	0.738
Parental help with homework	0.341***	0.097	0.244***	0.089	0.241***	0.090	0.343	0.637
Demographic characteristics and religion								
Age	-1.149**	0.473	-1.079***	0.406	-1.079***	0.410	-0.962	3.920
Age^2	0.034**	0.017	0.029**	0.015	0.029**	0.015	0.041	0.145
Non Muslim	-0.364**	0.153	-0.310**	0.127	-0.299**	0.128	-2.048	1.302
Female	-0.305***	0.082	-0.195***	0.071	-0.179***	0.072	-0.921	0.591
School characteristics								
School admits from any primary school	-0.503***	0.086	-0.334	0.314			-0.506	0.343
Islamic school	-1.928***	0.096	-1.587***	0.300			-1.420***	0.366
School has a library	0.197**	0.086	-0.099	0.300			-0.371	0.333
School has a computer	0.421***	0.084	0.677**	0.297			0.617**	0.314
Teacher behaviours								
Meet parents every 1 month	0.163*	0.099	0.012	0.349			0.186	0.365
Meet parents every 3 months	1.038***	0.117	1.025**	0.429			0.854*	0.452
Meet parents every 6 months	0.067	0.139	0.010	0.505			-0.168	0.521
At least 4 tests a year	1.016***	0.120	1.294***	0.435			1.144**	0.452
Almost all pupils attend class	0.717***	0.081	0.597**	0.288			0.797**	0.303
Constant	10.98***	3.231	11.14***	2.845	12.44	2.816	10.871	26.571

Table A18 (*continued*)

Variables	OLS		Multilevel Random-effect		OLS Fixed-effects		OLS Between-schools	
	Coeff.	SE	Coeff.	SE	Coeff.	SE	Coeff.	SE
sigma_u			1.769	0.154	2.137	0.182		
sigma_e			2.926	0.038	2.926	0.037		
rho			0.268	0.035	0.347	0.039		
Number of obs	7923		7923		7923		311	
Number of groups			311		311			

NB: Generalised residuals of auxiliary equations are substituted to observed effort, preferences and talent.
*** 1%; **5%; *10%

Table A19
Roemer regressions with school averages results – Mathematics and English.

Variables	Mathematics Multilevel random-effect		English Multilevel random-effect	
	Coeff.	SE	Coeff.	SE
Pupil's overall effort†				
Pupil's school effort				
Never/rarely perform low	0.047***	0.011	0.127***	0.016
Never/rarely incomplete work	0.071***	0.023	0.228***	0.045
Never/rarely lazy	0.113***	0.039	0.300***	0.041
Never/rarely disinterested	0.097***	0.033	0.041***	0.015
Never noisy (vs. rarely)	0.164***	0.030	-0.027***	0.011
Never punished	0.041***	0.034	0.060***	0.020
Not absent past 2 weeks	0.065***	0.015	0.068***	0.016
Pupil's preferences				
If no work becomes idle	0.145***	0.027	0.159***	0.022
Work preferred to leisure	-0.018	0.014	0.002	0.017
Pupil's talent				
Fear English class	0.061***	0.023	-0.112***	0.021
Being popular in class	0.145***	0.041	0.265***	0.046
Want to study further	0.048***	0.009	0.051***	0.008
Social background‡				
Mother incomplete primary	0.213*	0.095	0.197*	0.106
Mother complete primary	0.125***	0.102	0.302***	0.115
Mother incomplete secondary	0.195***	0.107	0.444***	0.119
Mother complete secondary	0.250***	0.117	0.480***	0.131
Mother some tertiary	0.416**	0.143	0.362**	0.161
Mother education unknown	0.260	0.165	-0.281	0.184
Father incomplete primary	0.068**	0.107	0.237**	0.120
Father complete primary	0.149	0.115	0.170	0.129
Father incomplete secondary	0.194***	0.107	0.335***	0.120
Father complete secondary	0.255***	0.110	0.554***	0.123
Father some tertiary	0.425***	0.115	0.844***	0.129
Father education unknown	-0.064	0.136	0.246	0.154
One news item	0.026	0.070	0.094	0.079
Two news items	0.368	0.107	0.004	0.119
Ownership of farming livestock	0.090***	0.063	0.288***	0.071
Parental effort‡				
House Tutor	0.413***	0.079	0.320***	0.089
Coaching centre	0.498***	0.074	0.584***	0.083
Parental help with homework	0.091***	0.080	0.242***	0.089
Demographic characteristics and religion				
Age	-0.185***	0.346	-1.079***	0.409
Age^2	0.001*	0.013	0.029*	0.015
Non Muslim	-0.219***	0.114	-0.297***	0.128
Female	-1.289***	0.064	-0.179***	0.071
School characteristics				
School admits from any primary school	0.801***	0.380	-1.631***	0.350
Islamic school	-1.546**	0.533	-2.142***	0.823
School has a library	-0.270	0.343	-0.346	0.313
School has a computer	0.768**	0.319	0.636**	0.286
Teacher behaviours				
Meet parents every 1 month	-0.341	0.355	0.275	0.341
Meet parents every 3 months	0.425***	0.456	0.969***	0.413
Meet parents every 6 months	-1.090	0.594	0.020	0.487
Meet parents if needed	0.619***	0.315	0.728***	0.289
At least 4 tests a year	-0.577**	0.350	0.995**	0.417
Almot all pupils attend class	0.841	0.348	-0.506	0.315

Table A19 (*continued*)

| | Mathematics | | English | |
| | Multilevel random-effect | | Multilevel random-effect | |
Variables	Coeff.	SE	Coeff.	SE
Average pupil's school effort at school-level				
Never/rarely perform low	0.091	0.098	0.045	0.146
Never/rarely incomplete work	-0.546	0.263	-0.087	0.473
Never/rarely lazy	0.215	0.413	-0.359	0.443
Never/rarely disinterested	0.536	0.374	0.092	0.079
Never noisy (vs. rarely)	-0.201	0.187	-0.001	0.073
Never punished	1.213***	0.399	0.567***	0.192
Not absent past 2 weeks	0.181	0.138	0.076	0.121
Average pupil's preferences at school-level				
No work becomes idle	-0.029	0.311	-0.057	0.207
Average pupil's talent at school-level				
Work preferred to leisure	0.148	0.179	0.147	0.179
Fear English class	0.367	0.300	0.059	0.254
Being popular in class	-0.020	0.577	0.054	0.516
Average social background at school-level				
Want to study further	-0.095	0.108	0.051	0.080
Mother incomplete primary	2.309	1.591	0.255	1.461
Mother complete primary	3.291	1.564	-0.006	1.433
Mother incomplete secondary	3.908	1.711	1.880	1.595
Mother complete secondary	2.875	1.945	1.243	1.758
Mother some tertiary	7.439*	2.784	5.757*	2.567
Mother education unknown	3.252*	2.337	4.173*	2.118
Father incomplete primary	-1.028	2.056	-0.341	1.912
Father complete primary	0.421	2.098	1.637	1.912
Father incomplete secondary	-1.213	1.770	-0.247	1.676
Father complete secondary	0.900	2.025	-1.884	1.845
Father some tertiary	1.877	2.111	0.570	1.855
Father education unknown	-1.667	2.130	-1.269	1.944
One news item	0.689	0.847	-0.117	0.787
Two news items	-1.367***	1.015	2.517***	0.920
Ownership of farming livestock	-2.238**	0.771	-1.583**	0.720
Average parental effort at school-level				
House Tutor	-2.126	0.806	-0.995	0.731
Coaching centre	-1.891	0.754	-0.869	0.701
Parental help with homework	0.701	0.685	0.323	0.617
Average demographic characteristics and religion at school-level				
Age	-1.500	4.071	-0.202	3.653
Age^2	0.072	0.153	0.022	0.135
Non Muslim	-1.120	1.372	-1.730	1.245
Female	0.403	0.609	-0.683	0.556
Constant	10.152	26.86	9.050	24.38
sigma_u	2.421	0.103	2.198	0.097
sigma_e	2.399	0.019	2.701	0.022
rho	0.505	0.022	0.398	0.022
Number of obs	7949		7923	
Number of groups	311		311	

*** 1%; **5%; *10%.

NB: Generalised residuals of auxiliary equations are substituted to observed overall effort measures.

†Pupil's overall effort measures are described in Table A1.

‡Social background and parental effort are described in Table A2.

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