National Foundation for
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Analysis of International Data on the Impact of Private Schooling – Hyderabad, India.

Statistics Research and Analysis Group (SRAG),
National Foundation for Educational Research (NFER),
United Kingdom.

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Summary

With the introduction of a growing number of private schools in the third world, several organisations and groups are endeavouring to examine the effects of such schooling systems on poor pupils.

Prof. James Tooley, the client, has collected data from seven regions internationally (three in India, three in Africa and one in China). For this particular dataset, Prof. Tooley directed research from 2003-2005 in 3 low income areas in Hyderabad[1], located in the South Indian state of Andhra Pradesh, India[2]. He ascertained a number of private schools providing education to the poor and collecting fees for their services[3].

This report outlines the analysis of examining a third world areas' dataset in relation to a mixed private and state schooling system. The initial analysis is for Hyderabad in India, and this data is examined with the presentation of the analysis and the findings which result.

The project's data comprises attainment scores as well as pupil, parent, school and teacher questionnaires and background variables. Analysis of data will be carried out in the first instance[4]. The main research question is: what evidence is there that, controlling for all available background data, pupils from poor families[5] do better in private as opposed to state schools.
In what follows, a detailed analysis using appropriate statistical methodologies will be presented together with a final conclusion.

[1] Source: The capital of the Andhra Pradesh state and 41st largest metropolitan area in the world (see Hyderabad location on map, p3), found @ http://en.wikipedia.org/wiki/Hyderabad,_India, accessed on 01/03/07. Population of 6,833,000 found @ http://www.graphicmaps.com/citypops.htm, accessed on 01/03/07.
[2] Source: Population of 1,129,866,154 (2007) found @ http://www.census.gov/cgi-bin/ipc/idbrank.pl, accessed on 01/03/07
[3] Source: found @ http://www.theatlantic.com/doc/200703/crook-schools, accessed on 12/03/07.
[4] With further work to follow as required.
[5] Poor families are refereed to in relation to low-income families; Source: 'Report: Private Schools for the Poor: A case from India', James Tooley and Pauline Dixon 2003, p.5.

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1. Introduction

Data that had been collected in the district of Hyderabad to investigate issues surrounding the efficiency of different school management structures for the education of children from poor families was provided by the University of Newcastle. The Statistics Research and Analysis Group (SRAG) of the National Foundation for Educational Research (NFER) was commissioned to carry out a detailed analysis of this data in order to address a range of research issues relating to the apparent impact of different management structures on pupils' attainment.

Data on a wide range of characteristics has been collected for 3910 pupils in Hyderabad, shown on Map 1, in 153 schools. The dataset comprises test scores, background information, pupil and parent questionnaire responses and information on the school attended.

Map 1 Hyderabad location on map[6]

Three school types have been considered and studied: (1) state, (2) private (recognised) and (3) private (unrecognised).

The research issues to be explored included:

- What are the relationships between pupil, school and teacher characteristics and pupil outcomes?
- Are there apparent differences in pupil attainment between school structures when other factors are taken into account?
- Do these differences vary according to pupil characteristics such as IQ, family income, sex or age?

The main outcomes were scores on tests in Mathematics, English and Urdu (though not all pupils were given the last test). No measure of prior attainment at an early time point was available, so the main proxy for this was an IQ measure acquired at the same time.

[6] Source: found @ https://www.cia.gov/cia/publications/factbook/print/in.html, accessed on 09/03/07.

As in all such complex data analysis endeavours, a number of decisions have to be made about how the data should be modelled effectively in order to gain robust insights into the research issues. One challenge with this dataset is the relatively large number of variables in comparison with the amount of data.

Many of these background variables are likely to be highly correlated with each other, and including all variables in a model would give very poor and generally unintrepretable results. The following strategy was therefore adopted in this case:

1. Data cleaning: background variables were divided into four categories: those relating to the pupil, the household (hh), the school and the teacher. Certain important background variables (e.g. IQ, income, age, sex) were left as separate factors.

2. Exploratory factor analysis methods were applied to each group of variables to define a smaller set of combined factors which explained most of the variance in the data.

3. By inspection of the factor loading it was possible to describe each of these combined factors in more general terms, and values for each pupil were estimated and rescaled to a mean of 50 and standard deviation of 10.

4. Multilevel modelling was used to explore the relationship between outcomes (scores in Mathematics, English and Urdu) and background measures, including the combined scales and the separate initial variables, and taking account of management type.

5. Results from the various models run were displayed as tables and charts, and interpreted in the light of the research issues.

The full data included 121 variables in total[7]. 101 are utilized in the analysis taking account of pupils, household (hh), school and teacher factors.

2. Analysis

The analysis stages consisted of the following:

1. Initial data cleaning and exploratory analysis,

2. Defining composites measures and imputing missing values. These were derived in such a way as to keep as much of the data as possible available for analysis. Factor Analysis determined the number of variables appropriate to use and so assisted in data reduction,

3. Multilevel modelling then followed in order to address the principle research questions, but also to explore interactions between school types and other factors, and

4. Conclusion: Results have been reported in tables, graphs and brief summary of findings.

[7] Refer to Annex 1 for full variables details.

2.1 Cleaning and Exploratory Analysis

2.1.1 Data Cleaning

The original dataset contains 121 various variables. After careful data examination, it was found that the dataset can be divided based on the most related variables to describe schooling system, pupils, household and teacher background information. Thus, the data were divided into four main datasets named: Pupil (including 35 variables), Household (hh) (including 25 variables), School (including 21 variables) and Teacher (including 20 variables)[8].

From the original total of 121 variables and after data cleaning, the total variables were now equal to 101.

2.1.2 Exploratory Analysis

From these four main derived datasets, exploratory data analysis was carried out. Descriptive analysis, basic frequencies and basic statistics were carried out for all the datasets' variables, including the number of missing values.

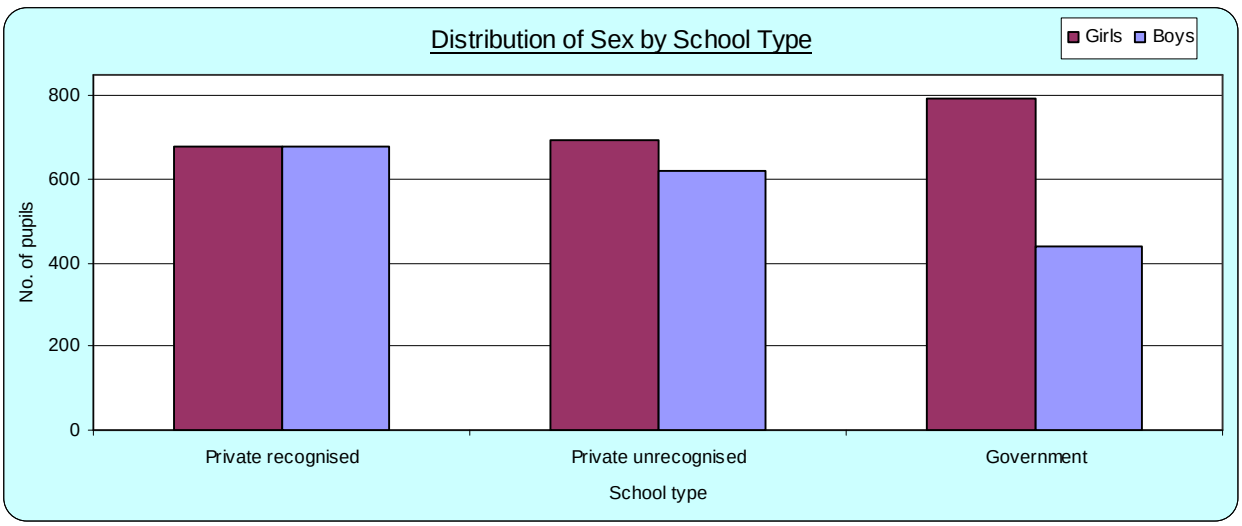
One of the exploratory analyses carried out is to examine the gender effect in school types. Table 1 shows the number of pupils in each school type and the percentages of these. Figure 1 shows an overview of the three different school types by sex. It highlights that there are significantly more girls than boys in government schools, compared with more or less the same level of girls and boys in private schools.

Table 1 School Type Statistics

School type

	Freq.	Percent	Cumulative
Private recognised	1355	34.7	34.7
Private unrecognised	1315	33.6	68.3
Government	1240	31.7	100.0

Figure 1 School Types by Sex

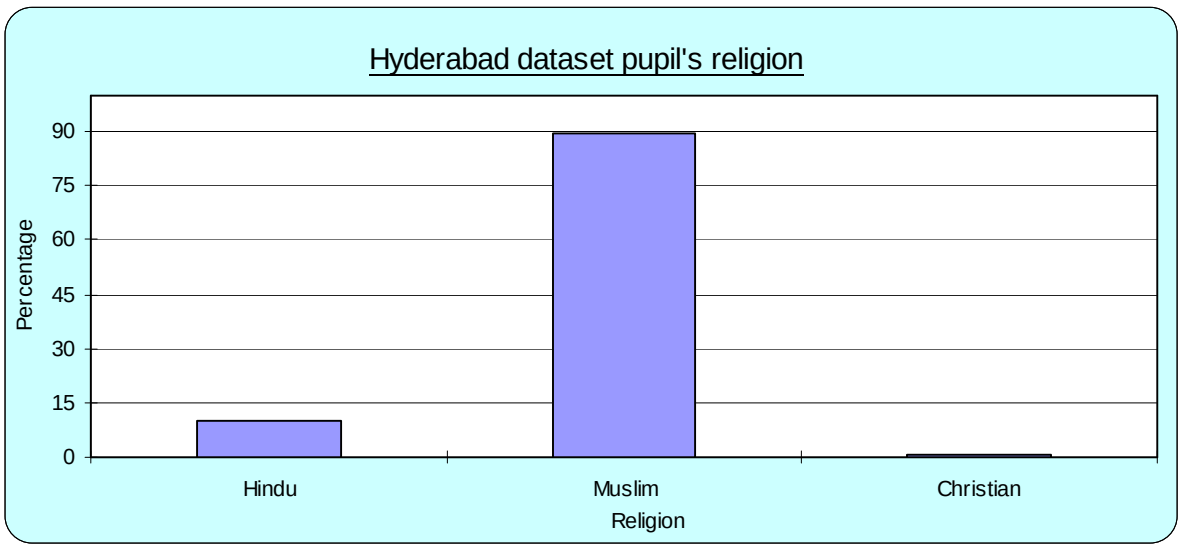


[8] Refer to Annex 2, Annex 3, Annex 4, Annex 5 for full variables details.

One might argue that in India, one the world's deprived countries with 35 per cent poverty[9], education is generally limited particularly in deprived areas. It would seem reasonable to assume that girls are less favoured by their families and parents to be provided a basic education in comparison to boys. Culturally, if so favoured, girls are highly likely to be placed in free government schools, as Figure 1 shows. However, what figure 1 also suggests is that overall more girls are attending school.

In terms of the pupil's religion, Figure 2 shows that Muslim pupils predominate with an 89% compared with Hindu and Christian with 10% and 1% respectively. This was to be expected – the population in the Old City of Hyderabad where the research was conducted is predominantly Muslim.

Figure 2 Proportion of pupil's religion



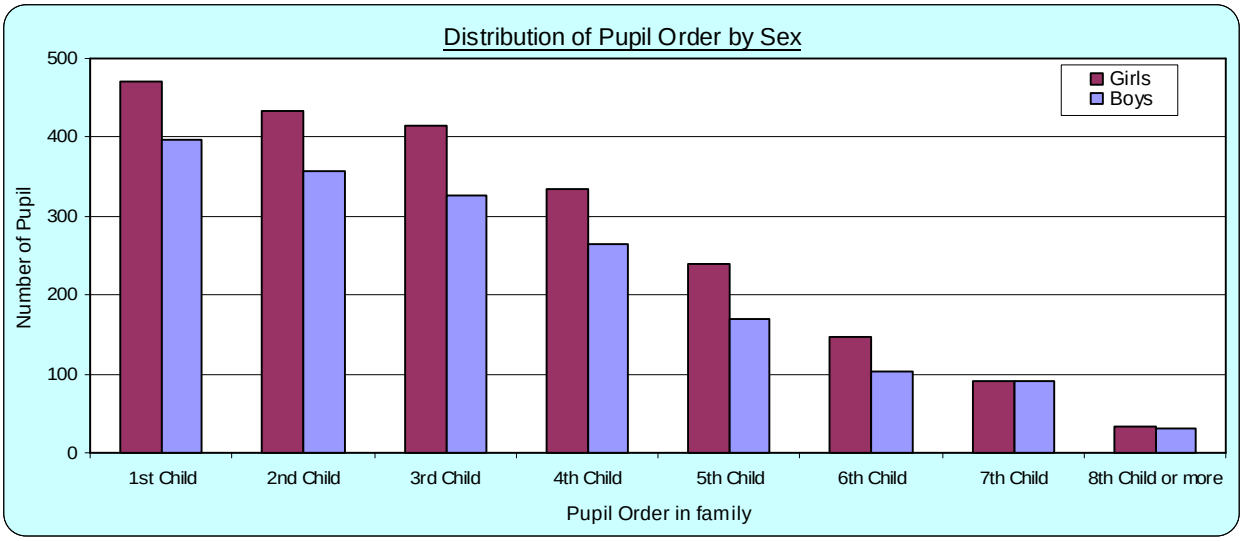
As indicated previously, the number of girls in the dataset is greater than that of boys. Table 2 shows the order of the total number of children in the family by sex. There is a monotonically decreasing trend as shown in Figure 3, as the pupil order in the family is decreasing.

Table 2 Pupil order in the family by sex

Summary Statistics			
Pupil Order	**Girls**	**Boys**	**Total**
1st Child	472	396	868
2nd Child	433	357	790
3rd Child	415	327	742
4th Child	335	264	599
5th Child	239	169	408
6th Child	147	103	250
7th Child	91	90	181
8th Child or more	33	30	63
Total	2165	1736	3901

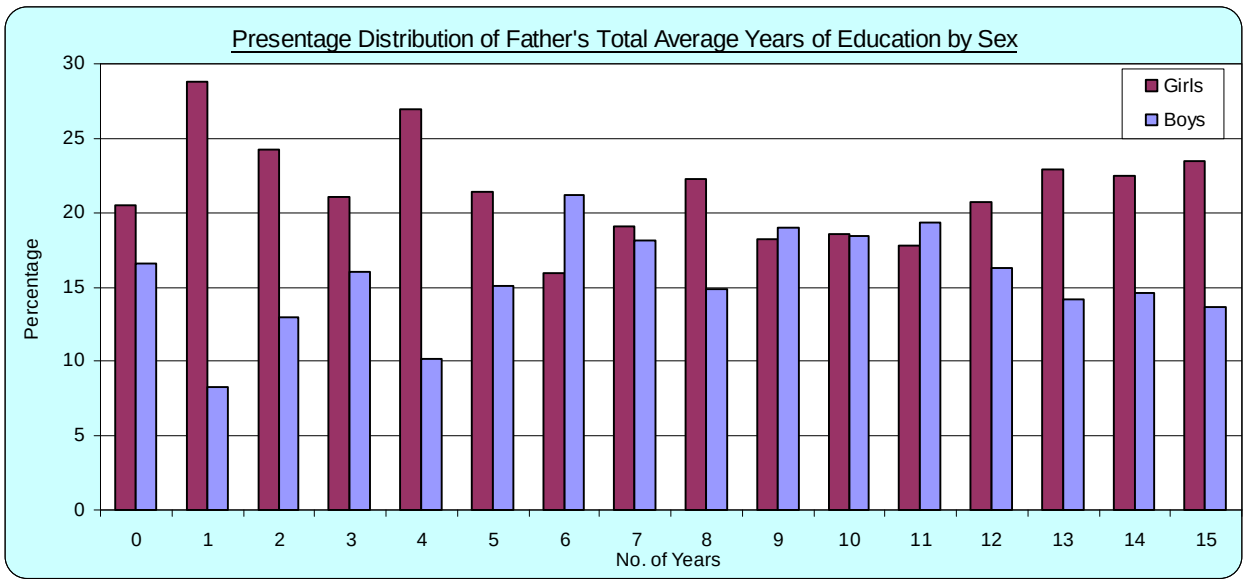
[9] Source: found @ ftp://ftp.fao.org/docrep/fao/009/a0750e/a0750e00.pdf, accessed on 05/02/07, p. 36. Population below US$1 Purchasing Power Parity (PPP) per day. India is the second poorest country after Bangladesh (36%) in the Asia and the Pacific region.

Figure 3 Pupil's order in the family by sex



From the exploratory data analysis, it can also be shown, in Figure 4, the percentages of father's total average years of education by sex. The percentages of girls greatly exceeded the boys in mainly the first 5 years. Overall, girls' percentages are higher than those of boys'.

Figure 4 Percentage distribution of father's total average years of education by sex



2.2 Factor Analysis

Factor Analysis (see Guertin & Bailey, Jr., 1970) is a formal decision making process to explicate subsets of covarying variables. It is developed to deal with the reduction of data where variables are difficult to define precisely. As a result, factor analysis is used to construct a number of relevant indicators/factors.

Factor analysis was carried out for Hyderabad data reduction and to show the variation and representation of the sample variables in terms of rotated number of factors. With the results of the factor loadings, it was generally possible to explain each of the combined factors; values of each pupil were estimated and rescaled to a mean of 50 and standard deviation of 10.

With the imputation of missing values[10] in order to have as a complete dataset as possible, the results of the factor analysis and combined loadings for each of the four datasets by using 3 factors are as follows.

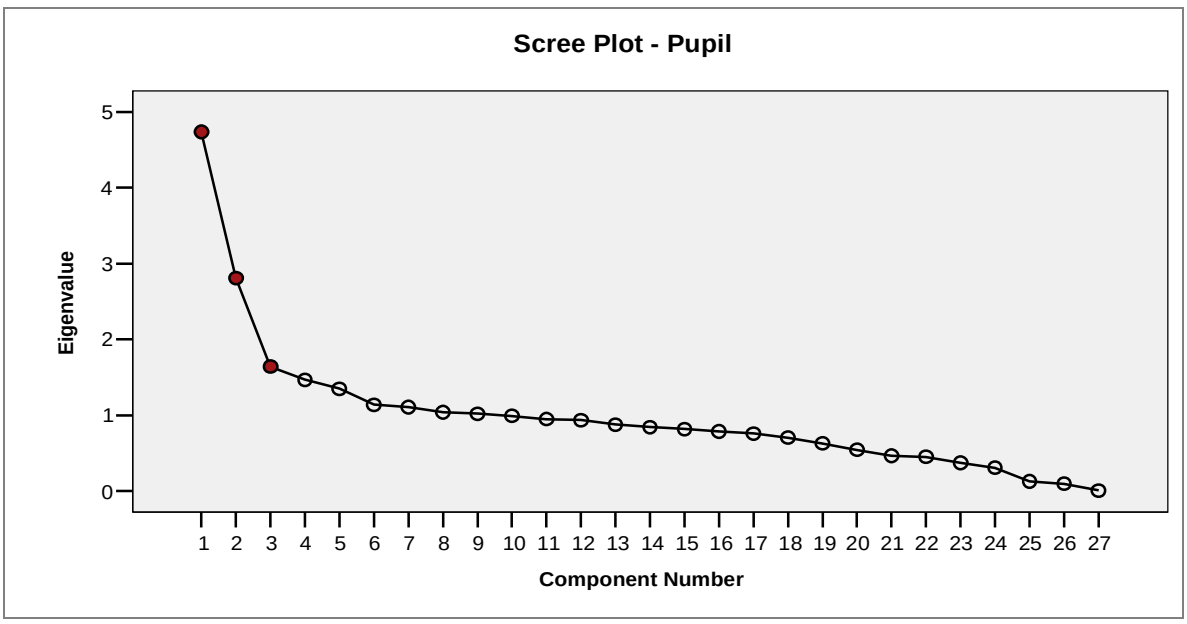
2.2.1 Pupil dataset

The factor analysis for the pupil dataset excluded 8 variables[11] that are necessary to have in the final model and the remaining 27 variables were analysed using 3 rotated factors, showing in the scree plot below. The 3 main significant factors that contribute most to the variation of pupil dataset are named and listed below.

Results:

1. PUP1 (*Factor 1)* explains mainly family education and employment.
2. PUP2 (*Factor 2)* explains mainly parents' aspirations/wishes for pupil.
3. PUP3 (*Factor 3)* explains mainly Muslim v. Hindu pupils, language and class.

Figure 5 Pupil Scree Plot



[10] Imputed missing values are carried out as the mean and binary variables were imputed with 'Not Stated' mean values.
[11] 'Age, gender, IQ, average IQ, Average class income, Maths results, English results and Urdu results' variables.

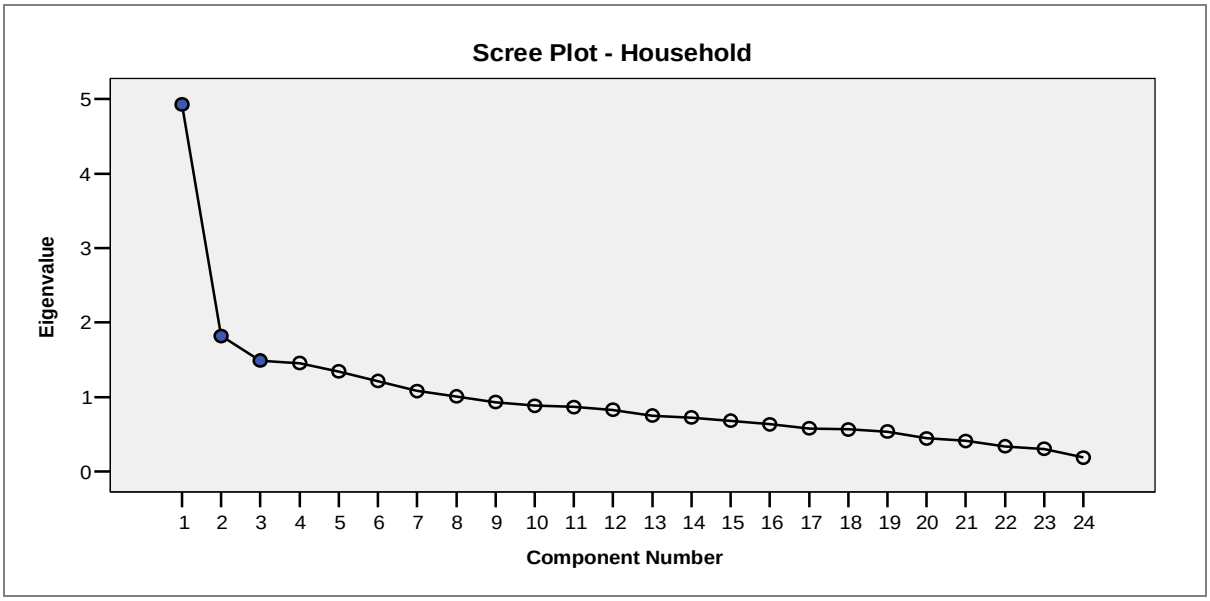
2.2.2 hh dataset

The factor analysis for the household dataset excluded 1 variable[12] and the remaining 24 variables were analysed using 3 rotated factors, which the scree plot shows below. The 3 main significant factors that contribute most to the variation of household dataset are named and listed below.

Results:

1. HH1 (*Factor 1)* explains mainly family possessions and education.
2. HH2 (*Factor 2)* explains mainly family size (adults).
3. HH3 (*Factor 3)* explains mainly family size (children) and distance between home and school.

Figure 6 Household Scree Plot



2.2.3 School dataset

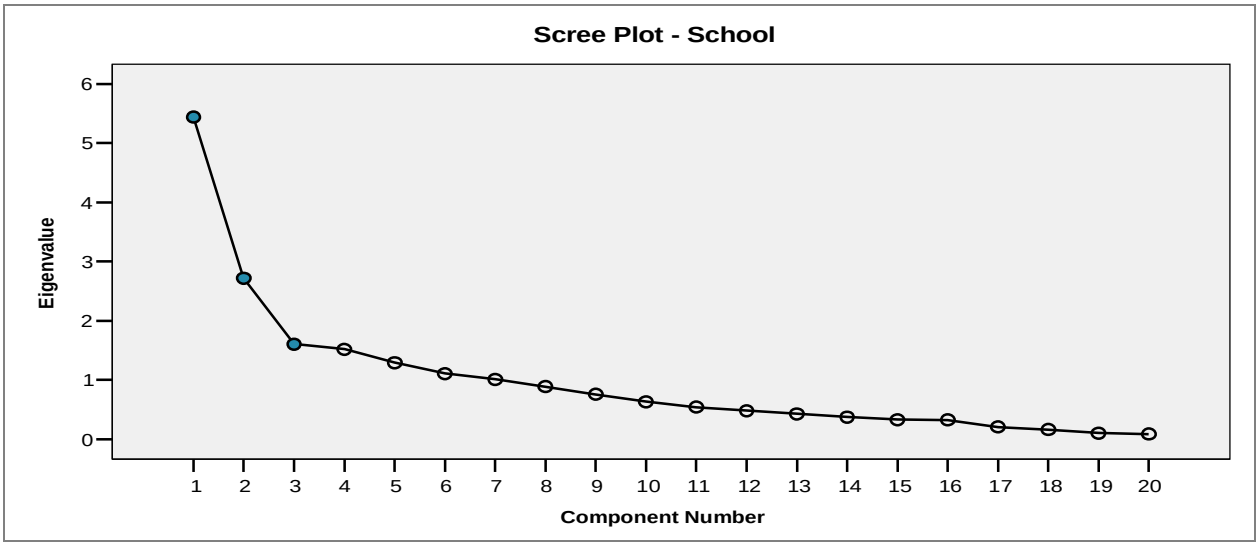
The factor analysis for the school dataset excluded 1 variable[13] and the remaining 20 variables were analysed using 3 rotated factors, which the scree plot shows below. The 3 main significant factors that contribute most to the variation of school dataset are named and listed below.

Results:

1. SCH1 (*Factor 1)* explains mainly School facilities and class 4 fees.
2. SCH2 (*Factor 2)* explains mainly School size.
3. SCH3 (*Factor 3)* explains mainly Teacher qualifications (certificate vs. degree).

[12] 'The family toilet is inside the premises' variable, as there is a similar variable with 'the family toilet is outside the premises' that is kept in the analysis.
[13] 'School type' variable as this is the default variable and need to be included in the final model.

Figure 7 School Scree Plot



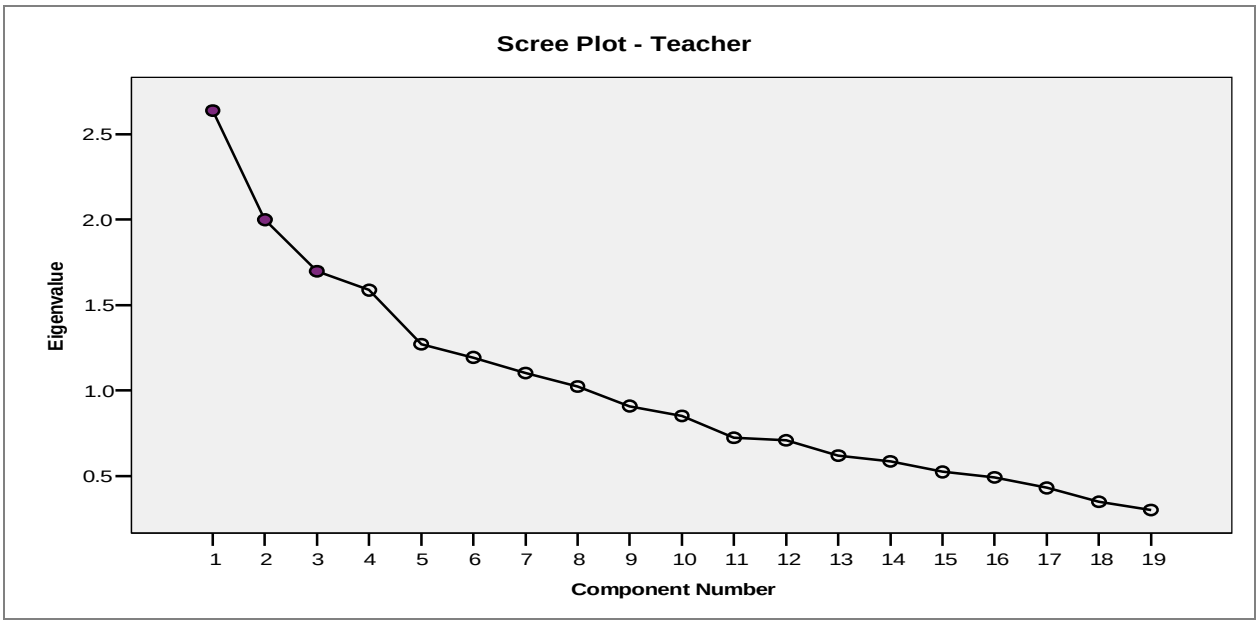
2.2.4 Teacher dataset

The factor analysis for the teacher dataset excluded 1 variable[14] and the remaining 19 variables were analysed using 3 rotated factors, which is shown in the scree plot below. The 3 main significant factors that contribute most to the variation of teacher dataset are named and listed below.

Results:

1. TCH1 (*Factor 1)* explains mainly Age, experience v. education & IQ.
2. TCH2 (*Factor 2)* explains mainly Training and qualifications & other jobs.
3. TCH3 (*Factor 3)* explains mainly Access to teaching tools.

Figure 8 Teacher Scree Plot



[14] 'Sex' variable, as this needed to be included in the final model.

2.3 Multilevel Modelling

Multilevel modelling (see Goldstein, 2003) is a development of regression analysis which takes account of data which is grouped into similar clusters at different levels. For example, individual pupils are grouped into classes, and those classes are grouped within schools. There may be more in common between pupils within the same class than with other classes, and there may be elements of similarity between different classes in the same school. Multilevel modelling allows us to take account of this hierarchical structure of the data and produce more accurate predictions, as well as estimates of the differences between pupils, between classes, and between schools.

In this dataset we were not able to identify classes within schools, so the model was set up with two levels: school and pupil. Three separate outcome measures were modelled – Mathematics, English and Urdu test scores, each standardised to have a mean of 50 and standard deviation of 10. All 3910 cases had mathematics and English scores, but only 3414 were tested in Urdu. The background variables fitted in the model included all the composites defined above, plus certain variables which were kept separate (sex, age, IQ, average class IQ, household income). For some of these, squared terms were included in the models in order to allow for possible non-linear effects. The variables concerned were age, IQ and income.

In order to address some of the research issues interaction terms were included in the models. These were created by multiplying together relevant variables in order to see if the coefficients of one variable were modified by the value of the other. For example, if we want to investigate if the relationship between outcome and IQ is different in different management types, we create a new variable which is the product of the indicator for the management type (e.g. private unrecognised) and the IQ (subtracted from its mean value). A positive coefficient for this new variable would imply that the relationship with IQ was stronger in private unrecognised schools than in the default type (state schools). In general we created two sets of interactions: with private unrecognised and private recognised schools, shown in Table 3 – state schools were regarded as the default type throughout. The variables for which such interactions were created were:

- IQ
- Parental expectations (PUP2)
- Income
- Age
- Sex (males versus females)

Table 3 Multilevel Modelling Interaction terms

No.	Variable label	Variable details
1.	PUNRIQ	private unrecognised by IQ
2.	PRECIQ	private recognised by IQ
3.	PUNRP2	private unrecognised by PUP2
4.	PRECP2	private recognised by PUP2
5.	INCOMESQ	Income (k) squared term
6.	PUNRINC	private unrecognised by income
7.	PRECINC	private recognised by income
8.	PAGESQ	age squared term
9.	PUNRAGE	private unrecognised by age
10.	PRECAGE	private recognised by age
11.	PUNRSEX	private unrecognised by sex
12.	PRECSEX	private recognised by sex

The random variances in the model basically allow for the differences between pupils in the same school in their performance, and differences between different schools overall, once other factors are taken into account. In addition, there were two other random elements included, both related to the relationship between outcome and IQ. The coefficient of IQ in the model shows how expected performance increases as IQ increases – in the basic model this 'slope' is assumed to be the same for all schools. In a 'random slopes' model we assume that this coefficient can vary from school to school and this assumption was made for these models. Furthermore, there was evidence that the standard deviation in the random pupil variations was lower for pupils with higher IQ. In order to model this, an extra random slope at the pupil level was introduced – see Goldstein (2003, pp63ff) for full details of this.

Variables which were clearly not significant in a particular model were deleted, but in some cases borderline significant variables were retained. The final models for each outcome are presented in Annex 6, Annex 7 and Annex 8, comprising random variances and fixed coefficients, with standard errors and 95% confidence intervals for each. These tables, however, are quite hard to interpret as they stand, and give no idea of the relative strength of the relationships between different factors and the outcomes. A way round this is the use of 'quasi effect sizes' or 'adjusted coefficients' (see Schagen and Elliot, 2004) – these enable us to present the results of complex models in a way which shows how much difference each factors makes to the expected pupil scores in each case. Annex 9 shows 'adjusted coefficients' for all three outcomes, for background factors which are statistically significant at the 5% level. An 'adjusted coefficient' shows the expected change in the outcome score which might be attributed to an 'average change' in the relevant background factor.

Based on this table, we may draw the following main conclusions from the analysis:

- All outcomes are strongly related to age, pupil's IQ, and class average IQ. In all that follows, we are looking at performance in mathematics, English and Urdu relative to these key factors.
- Pupils in private unrecognised and recognised schools, controlling for the above factors, appear to achieve higher scores in mathematics and English (though not Urdu) than equivalent pupils in state schools.
- Boys tend to have lower scores in English and Urdu than equivalent girls.
- There is a positive relationship between household income, family education and employment, and parental aspirations and English scores, but not for the other two outcomes, once other factors are taken into account.
- There is a slight negative relationship between the factor defining Muslim language versus Hindu language and culture and mathematics and English scores.
- There is a slight positive relationship between number of children in the family and Urdu scores.
- There is an apparent negative relationship between the size of the school and its amount of equipment and fees charged and the Urdu score.
- There is a slight negative relationship between the teacher's age and experience and English scores.

The above results relate to the overall relationships between background variables and outcomes, but do not include the significant interaction terms. We will now attempt to interpret these.

- The relationships between income and English and Urdu scores are slightly less strong for private unrecognised schools.
- The relationships between age and mathematics and English scores are slightly less strong in private recognised schools. Alternatively, the relatively better results for private recognised schools are reduced for older pupils.
- The results for boys in mathematics and English are relatively worse compared with girls in private unrecognised and recognised schools.

Another way of understanding the model results is to plot graphs showing expected outcomes for different groups of pupils, as a function of factors such as IQ or age. Some examples are given below.

Figures 9 and 10 show mathematics scores as a function of IQ and age respectively, for boys and girls in state schools and private unrecognised schools. Figures 11 to 13 show expected English scores as a function of IQ, age and income.

Figure 9 Expected Mathematics Score as a Function of IQ

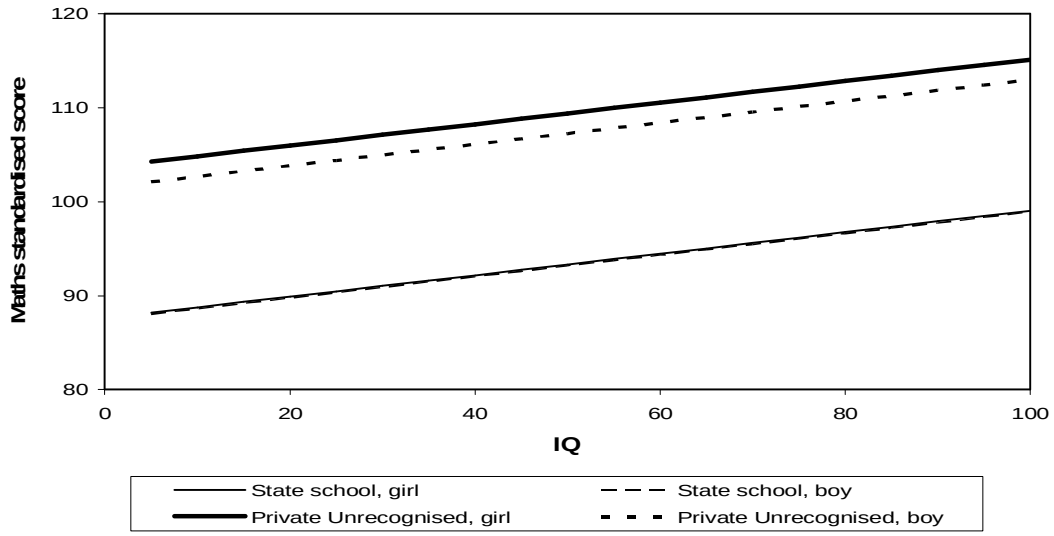


Figure 10 Expected Mathematics Score as a Function of Age

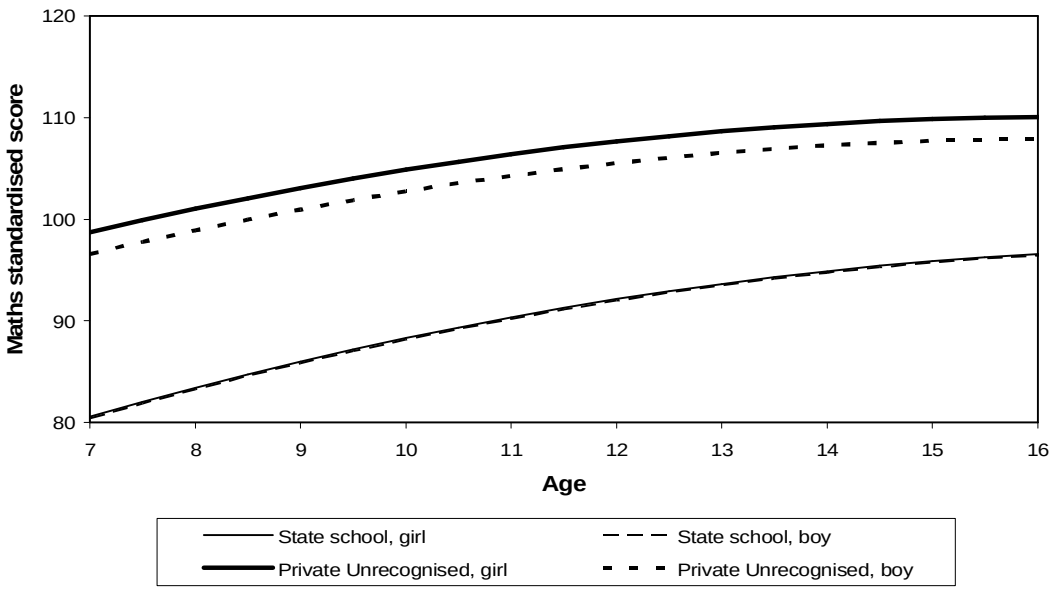


Figure 11 Expected English Score as a Function of IQ

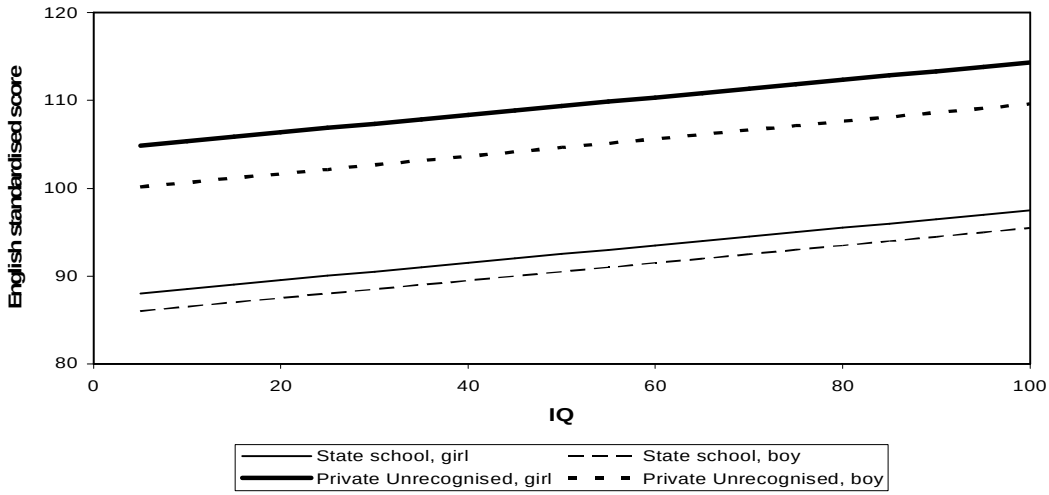


Figure 12 Expected English Score as a Function of Age

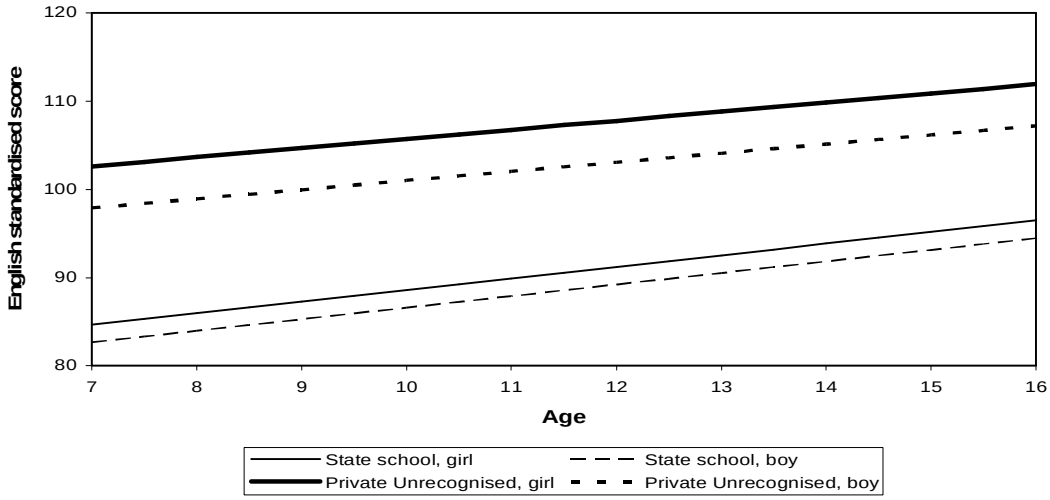
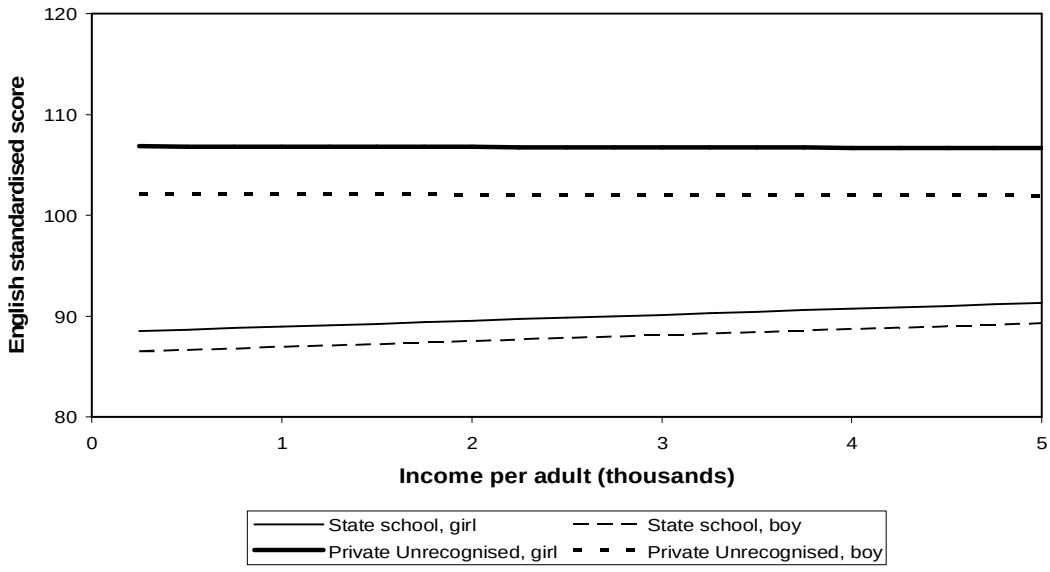


Figure 13 Expected English Score as a Function of Income



3. Conclusion

It is worth revisiting the original research questions and considering to what extent the analysis described above has addressed them.

- What are the relationships between pupil, school and teacher characteristics and pupil outcomes?

The strongest relationships are with IQ and age, with other background characteristics appearing to some extent. There may be some interest in the variables which do *not* appear to be related to outcomes. For example, income is only related to English scores, and most of the derived scales are not related, once age and IQ are taken into account.

- Are there apparent differences in pupil attainment between school structures when other factors are taken into account?

There is a clear difference between outcomes for state schools and private schools, controlling for IQ and age. The difference between private recognised and unrecognised schools appears not to be significant.

- Do these differences vary according to pupil characteristics such as IQ, family income, sex or age?

There are some apparent variations in the 'private school effect' – it is reduced, at least for Mathematics and English, for older pupils and boys. The small effect of income for state school pupils seems to mostly vanish for private schools.

Although the above findings from this data are clear and interesting, note should be taken of some caveats about over-interpretation of the results of the analysis. Statistical analysis can only control for factors which have been measured, and it also assumes that measurements in different settings are truly equivalent. It may be that there are other crucial factors and detailed background data which differ between state and private schools and are not captured by this data. For example, it could be hypothesised that private schools are better at providing their students with test-taking skills, or are more focused on the content of the tests which were used. The statistical analysis cannot explain to us the reasons why there are the observed differences, and these reasons may be worth further investigation.

The analysis of the Hyderabad data has been challenging, interesting and worthwhile. A number of leading international organisations, mainly United Nations organisations (such as UNESCO and UNDP) are taking positive steps in providing and conducting research in the area of private schooling for the poor. However, to draw more robust conclusions about the impact of private schools in developing countries would require the analysis of further datasets from other appropriate states in India. Generally, a more in-depth analysis and further work can be conducted to other deprived third world cities and countries individually and largely as a regional comparison, which will provide an eye into the impact of such escalating issue.

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Annex 1 Basic descriptive for Hyderabad Dataset

No	Variable	Min. value	Max. value	No. of cases	Description
1	S_SH_TP*	1	3	3910	Management type
2	GOV**	0	1	3910	The school is a government school
3	MAN2	0	1	3910	The school is private
4	MAN3	0	1	3910	The school is government
5	PRIUNREC	0	1	3910	The school is a private unrecognised school
6	PRIREC	0	1	3910	The school is a private recognised school
7	P_AGE	7.08	15.92	3900	Pupil's age
8	PAGE2	50.17	253.34	3900	Pupil's age squared
9	P_SEX	0	1	3901	Pupil's gender
10	P_HINDU	0	1	3897	Pupil is a Hindu
11	P_MUSIM	0	1	3897	Pupil is a Muslim
12	P_CHRIST	0	1	3897	Pupil is a Christian
13	P_WORK	0	1	3896	Pupil works during the holidays
14	P_ORDER	1	8	3903	Pupil's order in the family
15	P_PROF	0	1	3886	The pupil wants to be a professional
16	P_DEG	0	1	3868	The pupil wants to have a degree or higher
17	P_SH_YRS	0	7	3900	Number of years of pupil at present school
18	P_P_GOV	0	1	3858	The proportion of the child's school career in state schools
19	S_P_SZ	5	120	3901	Number of students in the class
20	S_POBYCL	0	1	3901	Proportion of boys in the class
21	P_WMINS	1	90	3847	Amount of time it takes the pupil to walk to school
22	P_HRSTW	0	60	3880	The total number of hours of study per week
23	P_HR_SHK	21	45	3901	Total number of hours in school per normal day
24	P_DY_ABM	0	30	3883	Number of days the student was absent from school
25	MATHS	0	78	3910	Pupil Test result in maths
26	MATHSP	0	100	3910	Pupil test result in Maths percentage
27	MTHSSD	-2.15	1.69	3910	Pupil test result in Maths standardised
28	ENGLISH	0	77	3910	Pupil Test result in English
29	ENGLISHP	0	100	3910	Pupil test result in English percentage
30	ENGSD	-1.75	1.93	3910	Pupil test result in English standardised
31	URDU	0	84	3414	Pupil Urdu score (note: not all pupils take this)
32	URDUP	0	100	3414	Pupil Urdu percentage
33	URDUSD	-1.19	2.32	3414	standardised score for Urdu
34	P_IQ	0	99	3901	Pupil Normed IQ using Bombay scale 0 to 100
35	NORMIQ2	0	9801	3901	Normed IQ squared
36	P_AVIQ	2.8	93.25	3903	Peer group effect average IQ for the whole class
37	P_LGH_UR	0	1	3633	The language spoken at home is Urdu
38	P_HM_LE	0	1	3633	An elder member of the family speaking English
39	HH_NEWSP	0	1	3632	The family gets a daily newspaper

No	Variable	Min. value	Max. value	No. of cases	Description
40	HH_SIB	1	12	3615	Number of siblings
41	P_G_CLS	0	1	3632	The pupil comes from a general caste
42	HH_N_BOK	0	260	3616	Number of books in the home
43	HMBOOK2	0	67600	3616	Number of books in the home squared
44	HH_CAR	0	1	3633	The household has a car or jeep
45	HH_MOCYL	0	1	3633	The household has a scooter or motorcycle
46	HH_BWTV	0	1	3633	The household has a black and white television
47	HH_COVT	0	1	3633	The household has a colour television
48	HH_PHN	0	1	3633	The household has a telephone
49	HH_FDG	0	1	3633	The household has a fridge
50	HH_TAPE	0	1	3633	The household has a tape recorder
51	HH_COKR	0	1	3633	The household has an LPG cooker
52	HH_RADIO	0	1	3633	The household has a radio
53	HH_LAND	0	1	3633	The household owns cultivated land
54	HH_BICYL	0	1	3633	The household has a bicycle
55	HH_ADSZ	1	18	3632	Number of adults in the family home
56	HH_CHSZ	1	21	3632	Number of children in the family home
57	HH_ADSZR	0.17	11	3630	Adults per room
58	HH_KITC	0	1	3628	The family home has a separate kitchen
59	HH_TOUT	0	1	3633	The family toilet is outside the premise
60	HH_TIN	0	1	3633	The family toilet is inside the premises
61	HH_OWHS	0	1	3628	The family owns their house
62	P_F_NED	0	1	3632	The father has no education
63	P_F_ADY	0	15.33	3792	Average of father's years of education
64	P_F_DY	0	20	3632	The number of years of the child's father's education
65	P_M_DY	0	22	3633	The number of years of the child's mother's education
66	P_FH_INC	0	1	3632	The child's father has an income
67	P_F_MEP	0	1	3630	The father is in manual wage employment
68	P_F_PF	0	1	3630	The child's father is a professional
69	P_M_HWF	0	1	3632	Mother is a housewife
70	P_F_DWG	0	1	3632	The father is a Daily wage earner
71	P_AVINC	1125	7669.23	3763	Average income in the class
72	HH_INC	100	20000	3410	Total household income per month in Rs./
73	INC2L	10000	4.00E+08	3410	Household income squared
74	HH_AD_IM	100	20000	3409	Household Income per adult in the family
75	HH_DIS_H	0	8	3529	The distance between the family home and school
76	HH_DIS_A	0	10	3507	The distance between the family home and
77	DISGMP	-10	7	3501	Distance of government minus private
78	P_P_ASP	1	7	3631	The parents' aspirations for the child
79	P_PT_DG	0	1	3631	The parent wishes their child to get a degree
80	T_AGE	17	51	3753	Teacher's age
81	TAGE2	289	2601	3753	Teacher's age squared
82	T_SEX	0	1	3789	Teacher's gender
83	T_SHYR_T	0	24	3619	The number of years worked in this school
84	T_XPYR_T	0	24	3619	Years of experience as a teacher

No	Variable	Min. value	Max. value	No. of cases	Description
85	T_CLASS	0	1	3789	The social group to which the teacher belongs
86	T_ED_DG	0	1	3789	The highest education level of the teacher
87	T_TRAN	0	1	3789	Teacher Training
88	T_SDJOB	0	1	3789	Teacher has a second job
89	T_QTST	0	360	3754	Minutes of quizzes or tests given to pupils
90	S_CLDK	0	1	3789	Desk is available in class for every child
91	S_CLFN	0	1	3789	Fan is available in class
92	S_TAPE	0	1	3789	Tape recorder availability
93	S_CHAIR	0	1	3789	Chairs/benches availability
94	S_ECLGT	0	1	3789	Electric light availability
95	MULTI	0	1	3789	Multi-grade teaching for 4 class of diff
96	T_AC_TGD	0	1	3789	The teacher has access to teacher guides
97	T_AC_DIC	0	1	3789	The teacher has access to dictionaries
98	T_AC_RBK	0	1	3789	The teacher has access to reference book
99	T_AC_MAP	0	1	3789	The teacher has access to maps
100	T_AC_SKT	0	1	3789	The teacher has access to science kits
101	T_AC_TV	0	1	3789	The teacher has access to a television
102	T_AC_LSP	0	1	3789	The teacher has access to lesson plans
103	T_U_TBKS	0	1	3789	Teacher uses textbooks in the classroom
104	T_H_OBLS	0	1	3789	The headteacher observes the lesson at l
105	T_TN_SER	0	1	3789	The teacher has undergone in-service training
106	T_IQ	13	57	3636	Teacher's IQ score (correct answers)
107	S_ESTYR	1929	2004	3910	Year in which school was established
108	S_HD_CG	0	6	3020	Number of times the headteacher has changed
109	S_SIZE	55	2790	3910	The total number of children at the school
110	S_PROBYS	0	1	3873	The proportion of boys in the school
111	SCHSIZE2	3025	7784100	3910	The number of children in the school squared
112	S_FS_C4	0	220	3910	Monthly fees for class 4
113	S_T_TCH	2	86	3910	total number of teachers
114	S_PRT_SL	0	1	3466	Proportion of teachers that are school leavers
115	S_PRT_CI	0	1	3466	Proportion of teachers with a trained certificate
116	S_PRT_DG	0	1	3444	Proportion of teachers with a degree of
117	S_BKSLIB	0	5000	3871	The number of books in the library
118	BOOKLIB2	0	25000000	3871	The number of books in the library squared
119	S_LBT_C4	0	1	3892	The pupils of class 4 spend time in the
120	S_PLGRND	0	1	3910	The school has a playground
121	S_COMPTS	0	1	3910	The school has computers for the children

* As in NFER code (all variables with _ are NFER codes).

** As in Original data codes (all variables with full name are original data codes).

Annex 2 Basic descriptive for Pupil Dataset

Pupils Dataset									
No.	Original CODE	NFER CODE	Definition	No.	Missing	Min	Max	Mean	Range
1	page	p_age	Pupil's age	3900	10	7	16	10.76	8.83
2	pgender	p_sex	Pupil's gender (0=girl, 1=boy)	3901	9	0	1	0.45	1.00
3	phindu	p_hindu	Pupil is a Hindu	3897	13	0	1	0.10	1.00
4	pmuslim	p_musim	Pupil is a Muslim	3897	13	0	1	0.90	1.00
5	pchrist	p_christ	Pupil is a Christian	3897	13	0	1	0.00	1.00
6	work	p_work	Pupil works during the holidays	3896	14	0	1	0.17	1.00
7	porder	p_order	Pupil's order in the family	3903	7	1	8	3.17	7.00
8	poccup	p_prof	The pupil wants to be a professional (0=No, 1=Yes)	3886	24	0	1	0.71	1.00
9	peducat	p_deg	The pupil wants to have a degree or higher (0=No, 1=Yes)	3868	42	0	1	0.70	1.00
10	pyrsps	p_sh_yrs	Number of years of pupil at present school	3900	10	0	7	4.26	7.00
11	pwalktim	p_wmins	Amount of time it takes the pupil to walk to school in minutes	3847	63	1	90	18.03	89.00
12	hmstudym	p_hrstw	The total number of hours of study per week at home	3880	30	0	60	13.60	60.00
13	schlhrs	p_hr_shk	Total number of hours in school per normal term week	3901	9	21	45	34.92	24.00
14	absent	p_dy_abm	Number of days the student was absent from school in the last month	3883	27	0	30	2.32	30.00
15	normiq	p_iq	Pupil Normed IQ using Bombay scale 0 to 100	3901	9	0	99	23.96	99.00
16	avgofiq	p_aviq	Peer group effect average IQ for the whole class	3903	7	3	93	23.95	90.45
17	langurdu	p_lgh_ur	The language spoken at home is urdu (0=No, 1=Yes)	3633	277	0	1	0.84	1.00
18	englis	p_hm_le	An elder member of the family speaking English fluently (0=No, 1=Yes)	3633	277	0	1	0.33	1.00
19	caste	p_g_cls	The pupil comes from a general caste (GC means not one of the Scheduled Castes or other so-called 'backward' classes) (0=No, 1=Yes)	3632	278	0	1	0.90	1.00
20	edufnon	p_f_ned	The father has education.(0 = Yes, 1 = No)	3632	278	0	1	0.31	1.00
21	avgofyrs	p_f_ady	Average of father's years of education for the class	3792	118	0	15	7.45	15.33
22	yrseduf	p_f-dy	The number of years of the child's father's (guardian's) education	3632	278	0	20	6.62	20.00
23	yrsedum	p_m_dy	The number of years of the child's mother's education	3633	277	0	22	5.27	22.00
24	incomf	p_fh_inc	The child's father has an income (0=No, 1=Yes)	3632	278	0	1	0.97	1.00
25	fmanual	p_f_mep	The father is in manual wage employment (0=No, 1=Yes)	3630	280	0	1	0.60	1.00
26	fprofmg	p_f_pf	The child's father is a professional or a manager (0=No, 1=Yes)	3630	280	0	1	0.15	1.00
27	mhwife	p_m_hwf	Mother is a housewife (0=No, 1=Yes)	3632	278	0	1	0.84	1.00
28	waged	p_f_dwg	The father is a Daily wage earner (0=No, 1=Yes)	3632	278	0	1	0.52	1.00

Pupils Dataset									
No.	Original CODE	NFER CODE	Definition	No.	Missing	Min	Max	Mean	Range
29	avgofinm	p_avinc	Average income in the class	3763	147	1125	7669	3356.7	6544.23
30	paraspir	p_p_asp	The parents' aspirations for the child *	3631	279	1	7	4.66	6.00
31	paspdg	p_pt_dg	The parent wishes their child to get a degree or above (0=No wish, happy with below degree, 1=Yes wish)	3631	279	0	1	0.51	1.00
32	p_mthsd	p_mthsd	Maths Test Results (sd *15)	3910	0	-32	25	0.00	57.64
33	p_engsd	p_engsd	English Test Results (sd *15)	3910	0	-26	29	0.00	55.31
34	p_urdsd	p_urdsd	Urdu Test Results (sd *15)	3414	496	-18	35	0.00	52.70
35	progov	p_p_gov	Proportion of Pupils' time spent in Gov Schools. 1.00 = 100% of time in Gov, 0.5 = 50% of time in Gov and in Private, 0 = No time in Gov School	3858	52	0	1	0.28	1.00

* 1 = I want my child to be able to read and write.
2 = I want my child to complete up to standard 8.
3 = I want my child to complete up to standard 10.
4 = I want my child to complete up to standard 12.
5 = I want my child to take a diploma or certificate.
6 = I want my child to take a degree.
7 = I want my child to become a professional engineer/doctor/law.

Annex 3 Basic descriptive for Household Dataset

Household Dataset									
No.	Original CODE	NFER CODE	Definition	No.	Missing	Min	Max	Mean	Range
1	hmnews	hh_newsp	The family gets a daily newspaper (0=No, 1=Yes)	3632	278	0	1	0.29	1.0
2	numbsib	hh_sib	Number of siblings	3615	295	1	12	4.30	11.0
3	hmbooks	hh_n_boks	Number of books in the home	3616	294	0	260	19.67	260.0
4	car	hh_car	The household has a car or jeep (0=No, 1=Yes)	3633	277	0	1	0.03	1.0
5	scoote	hh_mocyle	The household has a scooter or motorcycle (0=No, 1=Yes)	3633	277	0	1	0.36	1.0
6	tvbw	hh_bwtv	The household has a black and white television (0=No, 1=Yes)	3633	277	0	1	0.50	1.0
7	tvcol	hh_cotv	The household has a colour television (0=No, 1=Yes)	3633	277	0	1	0.31	1.0
8	teleph	hh_phn	The household has a telephone including a cell phone (0=No, 1=Yes)	3633	277	0	1	0.24	1.0
9	fridge	hh_fdg	The household has a fridge (0=No, 1=Yes)	3633	277	0	1	0.27	1.0
10	tape	hh_tape	The household has a tape recorder (0=No, 1=Yes)	3633	277	0	1	0.47	1.0
11	lpg	hh_cokr	The household has an LPG cooker (0=No, 1=Yes)	3633	277	0	1	0.46	1.0
12	radio	hh_radio	The household has a radio (0=No, 1=Yes)	3633	277	0	1	0.37	1.0
13	land	hh_land	The household owns cultivated land (0=No, 1=Yes)	3633	277	0	1	0.07	1.0
14	bicyle	hh_bicyle	The household has a bicycle (0=No, 1=Yes)	3633	277	0	1	0.67	1.0
15	adults	hh_adsz	Number of adults in the family home	3632	278	1	18	2.91	17.0
16	childs	hh_chsz	Number of children in the family home	3632	278	1	21	4.43	20.0
17	aproom	hh_adsz	Adults per room	3630	280	0.17	11	1.36	10.8
18	kitchen	hh_kitc	The family home has a separate kitchen for the family to use (0=No, 1=Yes)	3628	282	0	1	0.64	1.0
19	toilout	hh_tout	The family toilet is outside the premises (0=No, 1=Yes)	3633	277	0	1	0.22	1.0
20	toilin	hh_tin	The family toilet is inside the premises (0=No, 1=Yes)	3633	277	0	1	0.78	1.0
21	ownhm	hh_owhs	The family owns their house (0=No, 1=Yes)	3628	282	0	1	0.41	1.0
22	incom	hh_inc	Monthly total household income in Rs./-	3410	500	100	20000	3363.23	19900.0
23	incompa	hh_ad_im	Household Income per adult in the family home	3409	501	100	20000	2604.26	19900.0
24	disgov	s_dis_hg	The distance between the family home and the nearest government school	3529	381	0.001	8	0.75	8.0
25	dispriv	s_dis_hp	The distance between the family home and the nearest private school	3507	403	0.001	10	0.49	10.0

Annex 4 Basic descriptive for School Dataset

School Dataset									
No.	Original CODE	NFER CODE	Definition	No.	Missing	Min	Max	Mean	Range
1	man	s_sh_tp	School type	3910	0	1	3	1.97	2
2	clnum	s_p_sz	Number of students in the class	3901	9	5	120	43.42	115
3	pclboys	s_pobycl	Proportion of boys in the class	3901	9	0	1	0.47	1
4	desks	s_cldk	Desk is available in class for every child (0=No, 1=Yes)	3789	121	0	1	0.56	1
5	fan	s_clfn	Fan is available in class (0=No, 1=Yes)	3789	121	0	1	0.60	1
6	ttape	s_tape	Tape recorder availability (0=No, 1=Yes)	3789	121	0	1	0.33	1
7	chair	s_chair	Chairs/benches availability (0=No, 1=Yes)	3789	121	0	1	0.82	1
8	enlclght	s_eclgt	Electric light availability (0=No, 1=Yes)	3789	121	0	1	0.64	1
9	sestab	s_estyr	Year in which school was established	3910	0	1929	2004	1982.53	75
10	hdchang	s_hd_cg	Number of times the headteacher has changed in the last 10 years	3020	890	0	6	0.91	6
11	schsize	s_size	The total number of children at the school	3910	0	55	2790	558.71	2735
12	pboyss	s_probys	The proportion of boys in the school	3873	37	0	1	0.49	1
13	feecls4	s_fs_c4	Monthly fees for class 4	3910	0	0	220	67.83	220
14	numbtch	s_t_tch	total number of teachers	3910	0	2	86	16.50	84
15	ptsl	s_prt_slv	Proportion of teachers that are school leavers only	3466	444	0	1	0.18	1
16	pttc	s_prt_cif	Proportion of teachers with a trained teacher's certificate or degree	3466	444	0	1	0.20	1
17	ptdgree	s_prt_dg	Proportion of teachers with a degree of higher	3444	466	0	1	0.66	1
18	booklib	s_bkslib	The number of books in the library	3871	39	0	5000	481.58	5000
19	timlib	s_lbt_c4	The pupils of class 4 spend time in the library (0=No, 1=Yes)	3892	18	0	1	0.45	1
20	splay	s_plgrnd	The school has a playground (0=No, 1=Yes)	3910	0	0	1	0.48	1
21	scompu	s_compts	The school has computers for the children (0=No, 1=Yes)	3910	0	0	1	0.46	1

Annex 5 Basic descriptive for Teacher Dataset

Teacher Dataset									
No.	Original CODE	NFER CODE	Definition	No.	Missing	Min	Max	Mean	Range
1	tage	t_age	Teacher's age	3753	157	17	51	27.62	34
2	tsex	t_sex	Teacher's gender (0=female, 1=male)	3789	121	0	1	0.13	1
3	tyraats	t_shyr_t	The number of years worked in this school as a teacher	3619	291	0	24	3.46	24
4	texper	t_xpyr_t	Years of experience as a teacher	3619	291	0	24	5.54	24
5	tsocial	t_class	The social group to which the teacher belongs (0=Scheduled caste (SC), 1=General (G))	3789	121	0	1	0.76	1
6	teduhig	t_ed_dg	The highest education level of the teacher is a degree or above (0=No, 1=Yes)	3789	121	0	1	0.95	1
7	ttrain	t_tran	Teacher Training (0=None, 1=Training)	3789	121	0	1	0.47	1
8	tsecj	t_sdjob	Teacher has a second job (0=No, 1=Yes)	3789	121	0	1	0.30	1
9	teachg	t_ac_tgd	The teacher has access to teacher guides (0=No, 1=Yes)	3789	121	0	1	0.43	1
10	dic	t_ac_dic	The teacher has access to dictionaries (0=No, 1=Yes)	3789	121	0	1	0.60	1
11	refb	t_ac_rbk	The teacher has access to reference books (0=No, 1=Yes)	3789	121	0	1	0.65	1
12	maps	t_ac_map	The teacher has access to maps (0=No, 1=Yes)	3789	121	0	1	0.78	1
13	scikit	t_ac_skt	The teacher has access to science kits (0=No, 1=Yes)	3789	121	0	1	0.49	1
14	tv	t_ac_tv	The teacher has access to a television (0=No, 1=Yes)	3789	121	0	1	0.18	1
15	lesspls	t_ac_lsp	The teacher has access to lesson plans (0=No, 1=Yes)	3789	121	0	1	0.83	1
16	textbks	t_u_tbks	Teacher uses textbooks in the classroom (0=No, 1=Yes)	3789	121	0	1	0.87	1
17	headob	t_h_obls	The headteacher observes the lesson at least once per week (0=No, 1=Yes)	3789	121	0	1	0.67	1
18	insrv	t_tn_ser	The teacher has undergone inservice training (0=No, 1=Yes)	3789	121	0	1	0.44	1
19	travens	t_iq	Teacher's IQ score (correct answers) 0 to 60	3636	274	13	57	41.89	44
20	mintst	t_qtst	Minutes of quizzes or tests given to pupils on average per wk	3754	156	0	360	31.56	360

Annex 6 Detailed Multilevel Model results for Mathematics

				95% Confidence interval	
Parameter	**Estimate**	**Standard error**	**Sig.**	**Min.**	**Max.**
Base case					
School variance	97.290	11.860	*	74.044	120.536
Pupil variance	125.100	2.887	*	119.441	130.759
Final model (4)					
School variance	60.740	8.353	*	44.368	77.112
School IQ covariance	-0.197	0.095	*	-0.383	-0.011
School IQ variance	0.005	0.002	*	0.002	0.008
Pupil variance	112.200	5.078	*	102.247	122.153
Pupil IQ covariance	0.300	0.179		-0.051	0.652
Pupil IQ variance	-0.010	0.004	*	-0.018	-0.002
Fixed coefficients					
Constant	78.520	6.594	*	65.596	91.444
The school is a private unrecognised school	16.060	2.962	*	10.254	21.866
The school is a private recognised school	17.330	3.316	*	10.831	23.829
Pupil's age	1.914	0.244	*	1.436	2.392
Pupil sex (males)	-0.150	0.707		-1.536	1.235
Pupil Normed IQ using Bombay scale	0.114	0.011	*	0.093	0.136
Peer group effect average IQ for the whole class	0.103	0.050	*	0.004	0.202
Household Income per adult in the family	0.110	0.101		-0.087	0.307
PUPIL 3: Muslim v. Hindu, language and culture	-0.136	0.033	*	-0.201	-0.072
HH 3: family size (children)	0.040	0.023		-0.005	0.086
SCH 1: equipment & fees	-0.199	0.149		-0.491	0.093
Age squared term	-0.133	0.077		-0.283	0.017
Interaction private unrecognised by age	-0.520	0.350		-1.207	0.167
Interaction private recognised by age	-1.073	0.376	*	-1.810	-0.336
Interaction private unrecognised by sex	-1.979	0.943	*	-3.828	-0.130
Interaction private recognised by sex	-2.342	0.938	*	-4.180	-0.504

* - Estimate is significantly different from zero at the 5% level.

Annex 7 Detailed Multilevel Model results for English

				95% Confidence interval	
Parameter	**Estimate**	**Standard error**	**Sig.**	**Min.**	**Max.**
Base case					
School variance	121.700	14.480	*	93.319	150.081
Pupil variance	96.010	2.215	*	91.669	100.351
Final model (4)					
School variance	37.040	5.278	*	26.695	47.385
School IQ covariance	-0.045	0.064		-0.170	0.079
School IQ variance	0.004	0.001	*	0.001	0.006
Pupil variance	88.000	3.879	*	80.397	95.603
Pupil IQ covariance	0.015	0.135		-0.249	0.279
Pupil IQ variance	-0.003	0.003		-0.009	0.004
Fixed coefficients					
Constant	71.730	5.042	*	61.848	81.612
The school is a private unrecognised school	16.850	1.481	*	13.947	19.753
The school is a private recognised school	18.900	1.644	*	15.678	22.122
Pupil's age	1.313	0.210	*	0.901	1.725
Pupil sex (males)	-2.008	0.610	*	-3.204	-0.812
Pupil Normed IQ using Bombay scale	0.099	0.009	*	0.081	0.118
Peer group effect average IQ for the who	0.127	0.043	*	0.042	0.211
Household Income per adult in the family	0.590	0.252	*	0.096	1.083
PUPIL 1: Family Education and Employment	0.104	0.050	*	0.006	0.201
PUPIL 2: Parent's aspirations/wishes for	0.082	0.018	*	0.047	0.117
PUPIL 3: Muslim v. Hindu, language and culture	-0.080	0.029	*	-0.136	-0.024
HH 1: family possessions	-0.039	0.023		-0.083	0.005
TCH 1: age & experience	-0.132	0.067	*	-0.262	-0.001
Interaction private unrecognised by income	-0.630	0.294	*	-1.206	-0.054
Interaction private recognised by income	-0.400	0.275		-0.939	0.139
Interaction private unrecognised by age	-0.278	0.303		-0.872	0.315
Interaction private recognised by age	-1.214	0.318	*	-1.837	-0.591
Interaction private unrecognised by sex	-2.706	0.814	*	-4.302	-1.110
Interaction private recognised by sex	-2.540	0.810	*	-4.127	-0.953

* - Estimate is significantly different from zero at the 5% level.

Annex 8 Detailed Multilevel Model results for Urdu

				95% Confidence interval	
Parameter	**Estimate**	**Standard error**	**Sig.**	**Min.**	**Max.**
Base case					
School variance	83.660	11.100	*	61.904	105.416
Pupil variance	143.700	3.549	*	136.744	150.656
Final model (4)					
School variance	62.570	9.280	*	44.381	80.759
School IQ covariance	0.056	0.102		-0.145	0.256
School IQ variance	0.003	0.002		-0.001	0.007
Pupil variance	129.800	6.306	*	117.440	142.160
Pupil IQ covariance	-0.173	0.250		-0.663	0.317
Pupil IQ variance	0.011	0.007		-0.003	0.024
Fixed coefficients					
Constant	101.200	10.460	*	80.698	121.702
The school is a private unrecognised school	5.920	3.462		-0.866	12.706
The school is a private recognised school	6.259	4.026		-1.632	14.150
Pupil's age	1.298	0.175	*	0.956	1.640
Pupil sex (males)	-5.284	0.425	*	-6.117	-4.451
Pupil Normed IQ using Bombay scale 0 to	0.104	0.016	*	0.073	0.136
Peer group effect average IQ for the who	0.161	0.068	*	0.027	0.294
Household Income per adult in the family	0.326	0.312		-0.285	0.937
PUPIL 3: Muslim v. Hindu, language and culture	0.096	0.054		-0.010	0.203
HH 3: family size (children)	0.051	0.026	*	0.000	0.102
SCH 1: equipment & fees	-0.396	0.180	*	-0.749	-0.044
SCH 2: size	-0.238	0.117	*	-0.468	-0.009
Pupil IQ deviation squared	-0.039	0.041		-0.119	0.042
Income (k) squared term	0.048	0.024	*	0.001	0.095
Interaction private unrecognised by income	-0.904	0.373	*	-1.634	-0.174
Interaction private recognised by income	-0.560	0.374		-1.293	0.174

* - Estimate is significantly different from zero at the 5% level.

Annex 9 Adjusted Coefficients from Multilevel Modelling

Variable	Maths score	English score	Urdu score
The school is a private unrecognised school	16.1	16.9	
The school is a private recognised school	17.3	18.9	
Pupil's age	3.5	2.4	2.4
Pupil sex (males)		-2.0	-5.3
Pupil Normed IQ using Bombay scale	3.7	3.3	3.4
Peer group effect average IQ for the whole class	1.6	2.0	2.5
Household Income per adult in the family		1.6	
PUPIL 1: Family Education and Employment		1.4	
PUPIL 2: Parent's aspirations/wishes for pupil		1.1	
PUPIL 3: Muslim v. Hindu, language and culture	-1.7	-1.0	
HH 1: family possessions			
HH 2: family size (adults)			
HH 3: family size (children)			0.6
SCH 1: equipment & fees			-5.4
SCH 2: size			-2.8
SCH 3: teacher training (CI v. DG)			
TCH 1: age & experience		-1.7	
TCH 2: training			
TCH 3: access to equipment			
Pupil IQ deviation squared			
Interaction private unrecognised by IQ			
Interaction private recognised by IQ			
Interaction private unrecognised by PUP2			
Interaction private recognised by PUP2			
Income (k) squared term			1.0
Interaction private unrecognised by income		-0.9	-1.4
Interaction private recognised by income			
Age squared term			
Interaction private unrecognised by age			
Interaction private recognised by age	-1.1	-1.3	
Interaction private unrecognised by sex	-2.0	-2.7	
Interaction private recognised by sex	-2.3	-2.5	

(Adjusted coefficient = expected change in outcome score due to average change in variable)

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