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Student Achievement Conditioned Upon School Selection: Religious and Secular Secondary School Quality in Bangladesh

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In this paper we present new evidence on the impact of school characteristics on secondary student achievement using a rich data set from rural Bangladesh. We deal with a potentially important selectivity issue in the South Asian context: the non-random sorting of children into madrasas (Islamic faith schools). We do so by employing a combination of fixed effects and instrumental variable estimation techniques. Our empirical results do not reveal any difference in test scores between religious and secular schools when selection into secondary school is taken into account. However, we document significant learning deficit by gender and primary school type: girls and graduates of primary madrasas have significantly lower test scores even after controlling for school and classroom-specific unobservable correlates of learning.

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1. Introduction

A hallmark of the educational landscape in Muslim majority countries is the presence of madrasas or Islamic religious schools. In Bangladesh, government-registered madrasas are growing in numbers and offer a modern curriculum where children are educated in secular subjects alongside religious studies. Graduates of these madrasas are eligible for further education in mainstream, secular institutes of higher education in the country. In the rural areas of Bangladesh, public secondary schools are rare so that households' choices are limited between private secular and religious education. Unsurprisingly, modernized madrasa education is a popular option for many parents to educate boys and girls alike. Today, registered madrasas compete with secular schools in attracting female students -- nearly half of the registered madrasa students are girls (Asadullah and Chaudhury, 2006). Beyond the role played in equalizing access to secondary education by gender, the overall significance of madrasas in expanding educational opportunities remains unclear. Do these schools effectively impart important life skills and/or adequately prepare individuals for the labor market? This question is of relevance for governments in developing countries where religious school enrolment is on the rise. Yet, extant surveys on school quality in Bangladesh and elsewhere routinely leave out religious schools from the sample and are insufficiently designed to adequately address the question of relative quality of madrasas.

In the absence of comparable survey data on religious and secular schools, researchers have tried to use existing household survey data set that contains information on individuals' school type. Such data has been used by Beegle and Newhouse (2005) for Indonesia. Madrasas in Indonesia are similar to Bangladesh – they offer a modern curriculum and are recognized by the government. Beegle and Newhouse use public examination records on graduates of secondary junior schools and assess the relative effectiveness of private vs. public schools. The different school types examined were public madrasa, private secular, private madrasa, other private Muslim and non-Muslim religious schools. Their study finds that students attending public madrasas perform no worse than those attending public secular schools, and students attending private madrasas perform no worse than their counterparts in private secular schools. Whilst intriguing, it is difficult to say anything about the efficacy of religious school performance based on single country experience.

In this study, we assess the quality of religious and secular education in rural Bangladesh using a unique, large-scale survey of registered secondary schools. Quality is measured on the basis of the performance of students in mathematics. Assessing the quality of madrasas vis-à-vis secular schools is not straightforward using a cross section of data. In the rural areas with inadequate public provision, parents choose between private secular and religious schools. Despite adoption of a modern curriculum, religious schools differ from secular ones in many ways (e.g. they explicitly emphasize the importance of religious values and discipline in life). This raises the possibility of non-random selection. Parents who value secular learning over religious teaching opt for secular schools. Such parents may also instill in their children a strong desire to learn and/or spare more time at home to tutor children so that simple cross-section estimate of the relationship between private school (over madrasa) attendance and test score would be upward biased. Yet, we are not aware of any study that has addressed the question of what determines

selection into religious schools and how, conditional on selection, student learning in these schools compare to that in secular schools[1].

Such concern over non-random selection in schools on the basis of observed and unobserved parental/child attributes has been the subject matter of the broader discourse on the educational production function in the economics literature for the last two decades. Selection effects give rise to the problem of identification of educational production functions which have plagued much of the empirical literature on the determinants of student achievement. Consequently, the extant research on the relationship between student achievement and school inputs offer limited policy insights (Hanushek, 1997; Kremer, 2000; Todd and Wolpin, 2003; Case, 2005). This is particularly true for research on developing countries where school surveys seldom collect data on exogenous school inputs and are rarely designed to account for endogenous school choice (Glewwe, 2002). Designing surveys that gather detailed information on students, teachers and schools potentially limits the prospect of bias that arise owing to non-random sorting on the basis of observed attributes of the student or her family. But it may not fully rule out the possibility of selection on attributes that are unobserved by the researcher (Case, 2005). Ideally, one should exploit an experimental or quasi-experimental setting which gives rise to exogenous variation in educational inputs. In the absence of a 'natural' experiment or a randomized intervention, careful design of the sample with the explicit objective of circumventing the problem of identification is a pragmatic way forward.

Researchers who have sought to model school selection seek to find variables or "instruments" that are uncorrelated with student outcomes yet predicts selection into a given school type. A variety of instruments have been constructed in the literature either using supply- or demand-side information. The former relates to information on the availability of a given school type and attributes of schools available in one's residential vicinity. Developing country studies that have adopted the second strategy are Beegle and Newhouse (2005), Alderman et al (2001), Glewwe et al. (1995) and Glewwe and Jacoby (1994). The latter three are intuitively more appealing as they use characteristics of the school not chosen as the identifying variables, instead of data on the availability of a given school type. The demand-side instruments on the other hand exploit information on exogenous personal attributes that are correlated to preference for a particular school type yet arguably uncorrelated with learning outcomes. For example, in analyses of the influence of Catholic schooling on learning outcomes, US researchers used as instruments the religious beliefs of the student's family (Evans and Schwab, 1995; Neal, 1997), proportion of Catholics in the area, proximity of Catholic schooling, urbanity (Evans and Schwab, 1995; Neal, 1997), and interactions between religious beliefs and urbanity (Sander 1996). More recently Figlio and Stone (2000) have used variables such as the crime rate in the county, concentration of the public schools in the county (i.e. public school student to teacher ratios) and community characteristics to model selection into a given school type.

We address the question of selection into madrasas in an instrumental variable framework. Our study follows Alderman et al (2001) and use information on the quality of un-chosen school in one's administrative neighborhood to construct instruments. In addition, drawing upon the US studies, we use measures of parental religiosity as an additional instrument. To the best of our

[1] For instance, neither Beegle and Newhouse (2005) nor Bedi and Garg (2000) address the issue of selection into religious schools in their research using Indonesian data.

knowledge, there is no study for a developing country that has tried to model selection into religious schools. We further contribute to the existing literature by producing estimates of production functions that are identified on the basis of within-school variation in inputs.

2. Background: Secondary schooling in Bangladesh

Secondary education in Bangladesh spans grades 6 to 10. Secondary schools differ in terms of management type and their religious orientation. Most of these schools are managed and owned privately; share of public schools is very small at the secondary level. In the year 2003, there were 17386 secular and 8410 registered religious secondary schools in the country of which only 317 schools and 3 madrasas were publicly owned respectively. The registered madrasas account for 15% of the total post-primary enrolment in the country.

Despite private ownership, secondary schools and madrasas in the non-government sector remain under significant government influence. The majority of these educational institutions regularly receive aid from the government to finance teacher salary. Recognized madrasas also offer a modern curriculum where alongside religious subjects, students are educated in mathematics, science, English and geography. Upon completion of grade 10, they appear in the Secondary School Certificate (SSC) examination which is organized separately by the Madrasa Education Board. Graduates of madrasas are eligible for admission in mainstream secular educational institutes for higher education. They also compete with their secular schooled peers for employment in the public sector[2].

Reliable data on the performance of madrasa students are not available. In the absence of individual level test score data on secondary madrasas/schools, other extant studies have used data on labour market performance of graduates of different school types (e.g. see Asadullah, 2005a). Therefore, this study on secondary madrasas evidently fills the lacuna on the quality of religious and secular schools in the rural Bangladesh.

3. Methodology

As pointed out earlier, extant studies of the determinants of learning suffer from a number of methodological problems. Glewwe and Kremer (2006) critically review recent retrospective studies on developing countries. Four sources of potential biases are noted by the authors: (i) bias due to unobserved components of a child's innate ability and motivation, as well as parents' motivation; these unobserved elements could be positively correlated with school quality because high-ability children tend to enroll in higher quality schools; (ii) bias owing to non-random allocation of government funds to schools; (iii) a variety of sample selection bias (e.g bias arises if weak students are less likely to drop out of high quality schools, the impact of school quality could be underestimated. Biases can also arise due to the choices parents make regarding the schools their children attend and actions parents may take to change those schools, since this may also cause child and household variables to be correlated with unobserved components of school quality; (iv) bias due to omitted school and teacher quality variables.
Our analysis of the determinants of test score centers on the estimation of a reduced form educational production function as specified by equation (1):

[2] For a review of the madrasa education system in Bangladesh, see Asadullah and Chaudhury (2006).

$$T_{is} = X_i\beta'_1 + Y_i\beta'_2 + Z_s\beta'_3 + \varepsilon_{is} \quad \textbf{(1)}$$

where 'T_{is}' stands for test score of the i-th student of school *s*. X_i contains personal attributes including host of control for past scholastic achievement and type of primary school attended; Y_i contains household characteristics of the respondent; Z_s is current school-specific attributes. The standard method to estimate equation (1) is a simple ordinary least-squares (OLS) regression. Basically all of the estimates of education production functions surveyed in Hanushek (1997) use this method. The empirical strategy set out below significantly departs from this practice and accounts for several potential sources of bias listed above by Glewwe and Kremer[3].

Many of the biases in extant studies arise owing to the nature of the school-survey based dataset that is conventionally used to estimate equation (1). Extant surveys mostly use stratified sampling technique and use as primary sampling unit administrative units that are too large to constitute a school-catchment area. Moreover, researchers seldom have data on multiple schools in a given school-catchment area so that selection into a school is modeled by using variations in characteristics of schools that in reality do not capture the actual choice of schools facing an index child in the sample. Furthermore, surveys sample pupils from single classrooms even if a school operates with multiple classrooms per grade so that within school variation in inputs such as class-size is ignored. Even when pupils belonging to a single classroom are interviewed, only a sub-sample is selected on a random basis so that there is limited variation in student characteristics. When the sample comprises of (i) all schools in a catchment area, (ii) multiple sections (classrooms) of a given grade and (iii) all kids in a section/classroom, the following educational production function could be estimated instead of equation (1):

$$T_{ijsc} = X_{ijsc}\alpha'_1 + Y_{ijsc}\alpha'_2 + Z_s\alpha'_3 + \eta_r + \lambda_s + \omega_c + u_{ijsc} \quad \textbf{(2)}$$

In equation (2), T_{ijsc} is test score of the i-th student in class *c*, school *s* and region *j*. The term η_r is an i.i.d random region (i.e. primary sampling unit) component, γ_s, is an i.i.d random school component and the term ω_c an i.i.d random class component; u_{ijsc} is the idiosyncratic (student-specific) component of the error term. Z, the vector of current school-specific attributes, controls for school type (whether a religious school) and factors such as fraction of teachers being female, fraction of teachers being trained, log of total school expenditure, class size and so on[4]. The vector Y controls for family factors (such as paternal and maternal education; housing quality; household assets) whilst the vector X controls for past achievement of the child (proxied by the class rank of the student in the grade final examination, administered by the school in the previous year) and past schooling history (e.g. religious orientation of primary school attended by the child).

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[3] Given that our sample is school-based, we cannot account for biases relating to non-random pattern of school participation. Studies that have accounted for sample selection effects due to premature drop out (e.g. Glewwe and Jacoby, 1995) in addition to selection in a given school type, conditional on enrolment, report limited impact of sample selection effects on the results. However, it is difficult to generalize this result and rule out the prospect of a selection bias for Bangladesh on the basis of this finding.

[4] We prefer class size experienced in the previous year as it is less endogenous compared to current (grade 8) class size.

Given the structure of the error term in equation (2), one can control for various types of unobservable factors by adopting a fixed-effects (FEs) regression framework instead of a simple OLS model. First, we note that secondary school availability in rural Bangladesh varies significantly between regions so that control for region-specific unobservables accounts for geographic differences in access to schools[5]. Therefore we estimate equation (2) controlling for region FEs and hence differencing out the term η_r. This approach is superior to that adopted by Beegle and Newhouse (2005) who account for selection into private school by using information on public school availability in the community. Control for regional FEs already a priori rules out selection in a given school type (e.g. secondary public school) purely for reasons related to its local availability.

The resulting estimates of school-specific parameters (e.g. coefficient on the religious school dummy) however are not necessarily causal even in a regional FE framework. Two important sorting effects discussed in Glewwe and Kremer (2006) are relevant here -- sorting taking place between-school (owing to residential choice) and within-school (owing to parents lobbying to place their children in a particular classroom or heads of schools assigning students to different classes). In a rural setting, one can arguably rule out the second scenario. However, the possibility of between school sorting remains. Parents may have a preference for a particular type of education (religious vs. secular) or they may care about some aspect of education quality that is correlated to a school's religious orientation. Even if rural parents do not move houses to be close to good schools, they may succeed in influencing local school funding and quality. In such cases, a positive relationship between school resources and outcomes for children may be due to unobserved parental tastes for education, and it may not be possible to disentangle the effects of such tastes from those of school inputs.

The identification strategy used in this paper tries to eliminate this between-school sorting effects by controlling for school fixed effects. Any systematic between-school variation stemming from any source whatsoever is thereby removed when estimating the class-size effect and effect of past inputs[6]. However, controlling for school fixed-effects means that we are unable to explore the effect of school-level determinants of learning such as religious orientation of secondary school, our key variable of interest in this study. Nonetheless, this strategy is still relevant as in this setting, we can investigate the impact of religious orientation of the primary school attended by kids in our sample. To the extent students in the same class differ in terms of pre-secondary education background, this strategy yields a cleaner estimate of the effect of primary madrasa education on secondary school achievement. For the same reason, despite limited prospect for within school sorting in rural areas, we exploit data on multiple students per classroom and further estimate class-room fixed-effects models (CFE). Whilst this strategy does not permit an analysis of the effect of school/class-specific variables, it yields finer estimates of the impact of past school inputs such as primary education in religious schools and enrolment in pre-primary (maktab) schools.

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[5] For instance, the supply of rural public secondary schools only varies between unions in Bangladesh; there is no rural union with more than one public secondary school.

[6] A previous study by Asadullah (2005b) exploits a teacher allocation rule, similar to the Maimonides' rule, where a public as well as an aided secondary school receive an additional teacher from the government if grade enrolment exceeds 60. The study does not provide any evidence in support of reducing class size in the secondary schools[6]. Unfortunately, this rule has been abolished in 2003 and hence does not any longer serve as a source of exogenous variation in class size in Bangladesh.

Clearly, school and classroom FEs approaches do not permit estimation of individual secondary school-specific variables such as religious school type. Therefore, to examine the impact of secondary madrasa attendance, we combine regional fixed-effects approach with instrumental variable technique and estimate regional FEs IV models[7]. The key challenge here is to find plausible instruments – variables correlated with the observed variables that are not orthogonal to the error term but uncorrelated with the error term. We use data on parental religiosity and relative characteristics of secular schools in the catchment area to construct instruments for the religious school attendance dummy.

4. Data

The data used in this paper was originally collected in 2005 to assess secondary school quality in rural Bangladesh that has benefited from a female stipend scheme. Jointly initiated by the World Bank and the Government of Bangladesh in 1993, the Female Secondary School Assistance Project (FSSAP) is one of the four stipend schemes and today covers over 5000 secondary educational institutes in a total of 118 Thanas and 1063 unions[8]. The primary sampling unit (PSU) of the survey was chosen to be unions. To account for regional variation in school participation rate and so on, PSUs were selected with proportional allocation from each division. Keeping in view the time, cost and administrative problems of managing large volumes of information and data, 60 unions with proportional allocation from 6 administrative divisions were selected. In the second step, for each sample union, a complete list of schools was prepared according to the Ministry of Education database on secondary schools in our sample unions. Using this list, all recognized schools and madrasas in the selected unions were surveyed. In total, 321 religious (madrasa) and secular schools could be identified in the 60 unions of which 83% are co-educational. Madrasas account for 29% of our sample (N=94).

As part of the survey, a secondary-standard mathematics test was administered on all students (both boys and girls) enrolled in grade 8 and present on the day of the survey. If there were two classrooms in grade 8, both were selected for the survey. However, if any of the schools had more than two classrooms, only two were randomly selected. Once again, all students present on the day of the survey were interviewed. Given the cluster-based sampling, the survey led to a near-census of all secondary school going children (currently enrolled in grade 8 and present on the day of the survey) in the sample PSUs. The survey led to a dataset on 8475 students.

The maths test instrument was constructed by using items previously used in the Trends in International Mathematics and Science Study (TIMSS), 1999. The TIMSS has been administered three times by the International Association for the Evaluation of Educational Achievement (IEA), the latest in 2003. The study has released several secondary-standard (grade 8) mathematics items indicating what each item measures and the results of every participating country. The TIMSS instrument assessed competency in data, measurement, number, algebra

[7] Beegle and Newhouse (2005) follow a similar methodology using Indonesian household data to account for selection into private school. Achievement regressions are estimated using OLS, fixed-effects (using within family data on siblings) and IV techniques. The authors estimate the IV model by using information on public school availability in the community. However, they do not address the issue of selection into religious schools.

[8] A union is an administrative unit in rural Bangladesh. It is smaller than a thana and typically comprises of about 15 villages.

and geometry using 125 multiple-choice format mathematics items[9]. On the basis of pilot test experience and given the time constraint in the field, only 20 original items were retained in our test instrument. These included 9 questions on number and fractions, 3 on geometry, 6 on algebra, 1 on graph and one on measurement.

In addition to test scores, the survey collected data on a host of school and teacher characteristics. Each student taking the test was asked to answer a number of questions relating to their family and parental background. Detailed data on personal characteristics and the history of pre-secondary schooling (such as the type of primary school attended) were also collected. Lastly, the head teacher of each sample school was interviewed to gather data on various aspects of the school and average background of teachers. If the head teacher was absent, the teacher-in-charge was interviewed. Additionally, school registers were accessed to collect data on student performance in school final examination in grade 7 in the previous year.

[9] It also contained 37 free-response format questions which were not considered whilst designing our test instrument. See Garden and Smith (2000) for details.

Table 1: Descriptive statistics

Variable	Mean	Std. Dev.
fraction of mathematics answers correct	0.38	0.20
Personal attributes		
Age	13.23	0.95
Age squared	175.84	29.68
Female*	0.63	0.48
Family background		
Father un-educated*	0.16	0.37
Father primary educated*	0.33	0.47
Father secondary educated*	0.20	0.40
Father post-secondary educated*	0.23	0.42
Mother un-educated*	0.24	0.43
Mother primary educated*	0.39	0.49
Mother secondary educated*	0.18	0.38
Mother post-secondary educated*	0.10	0.29
House is pucca*	0.14	0.34
House is semi-pucca*	0.16	0.36
House is kucca*	0.41	0.49
House is tin-made*	0.30	0.46
Travel time to school from home (in minutes)	22.40	18.59
Frequency with which father prays to God	1.76	1.83
Schooling history		
Attended pre-primary (maktab) school in the childhood*	0.62	0.49
Class rank in grade 7	22.17	21.63
Attended primary private school*	0.19	0.39
Attended primary madrasa*	0.05	0.21
Attended primary NGO school*	0.07	0.26
Attended primary grade in this school*	0.03	0.18
Attended primary government school*	0.65	0.48
Secondary school attributes		
Class size	62.21	30.68
Distance to the nearest secondary school	3.76	1.09
School expenditure (in logs)	13.29	0.99
Years to recognition	8.10	11.75
Received best school award from the government*	0.12	0.32
Fraction of grade 8 teachers being female	0.12	0.13
Fraction of grade 8 teachers being trained	0.47	0.28
Madrasa*	0.20	0.40
Single-sex school	0.16	0.37
Class size of the neighbouring school/madrasa	33.63	27.13
N	7710	

Note: * indicates a dummy (1/0) variable. Omitted class for parental education variable is “never went to school”. Base category for house type and primary school type is “kacha” and “government primary school” respectively.

5. Determinants of secondary school achievement: Regression results

We start with a relatively naïve regression specification which controls for PSU-specific fixed effects in addition to the usual student, household and school specific covariates of test score. This specification allows us to study determinants of test score by restricting school choice net of differences in the characteristics of school catchment area (i.e. PSU): we difference out any between-region variation in school availability. The majority of children (89%) attend school that is located in the same region (PSU) where they reside. Therefore, control for region-specific fixed effects partly addresses concern over the endogeneity of attending a particular school to the extent selection in a given school type is driven by it is availability in one's region of residence.

Results are reported in Table 2. Two versions of region fixed effects models are reported. The first is a parsimonious version (column 1) which limits control for school-specific factors to religious orientation of the school whilst the second specification controls for all school-specific factors. The coefficient on madrasa dummy is negative and significant indicating that students in madrasas are disadvantaged compared to their peers in schools in a given region. However, once we fully control for other school characteristics (such as sex-orientation, school expenditure, class size, average teacher attributes etc.), size of the coefficient on the madrasa dummy drops from -0.04 to -0.01. Several additional findings follow from column (2). First, girls score significantly less compared to boys. Second, students who received pre-primary education (maktab) during their childhood have significantly high test scores. Third, graduates of primary madrasas significantly under-perform compared to public primary schools. Fourth, students who rank low amongst their peers in the pervious grade (i.e. seventh) also perform poorly in our maths test[10]. Turning to school specific effects, schools with a larger fraction of female teachers boost test score significantly. Students in schools that have received "best school award" from the FSSAP authority in a given thana also perform significantly well[11]. Lastly, schools with higher expenditure perform significantly better (although the effect is modest).

Results presented in columns (1) and (2) whilst intriguing are difficult to interpret as causal. A majority (65%) of our PSUs have at least one school and a madrasa so that the question of non-random selection between secular and religious education is relevant for our data. Hence, we re-estimate the region FEs model treating the decision to attend a religious school as endogenous. Results are reported in column (3).

[10] We also recalculated class rank of the student in the seventh grade school final examination using performance in the mathematics paper only. However, our conclusion remained unchanged.

[11] All recognised schools and madrasas with female students in a given thana are eligible for the award.

Table 2: Determinants of student achievement [Dependent variable: % of correct answers in the secondary-level mathematics test]

	(1)	(2)	(3)	(4)	(5)
	Region FE	Region FE	Region FE-IV	School FE	Classroom FE
Student attributes					
Age	0.010	0.012	0.012	-0.003	-0.003
	(2.22)*	(1.64)	(2.56)*	(0.54)	(0.53)
Age squared	-0.000	-0.000	-0.000	0.000	0.000
	(5.13)**	(2.16)*	(5.30)**	(0.11)	(0.08)
Female	-0.006	-0.010	-0.010	-0.017	-0.017
	(1.45)	(2.50)*	(2.49)*	(5.53)**	(5.09)**
Family background					
Father primary educated	-0.003	-0.004	-0.004	-0.003	-0.003
	(0.66)	(0.79)	(0.86)	(0.79)	(0.87)
Father secondary educated	0.001	0.002	0.001	0.005	0.005
	(0.19)	(0.25)	(0.21)	(1.07)	(1.12)
Father higher educated	0.000	-0.000	-0.001	0.012	0.013
	(0.05)	(0.01)	(0.12)	(2.71)**	(2.84)**
Mother primary educated	0.007	0.007	0.007	0.007	0.007
	(1.49)	(1.45)	(1.47)	(2.22)*	(2.19)*
Mother secondary educated	-0.000	0.002	0.002	0.008	0.008
	(0.00)	(0.26)	(0.31)	(1.76)+	(1.87)+
Mother higher educated	0.014	0.014	0.014	0.015	0.015
	(1.76)+	(1.80)+	(1.84)+	(2.63)**	(2.56)*
Household has a fan	0.003	0.004	0.003	0.007	0.006
	(0.70)	(0.72)	(0.71)	(1.86)+	(1.69)+
Household has a tv	0.003	0.003	0.004	0.004	0.003
	(0.68)	(0.73)	(0.87)	(1.03)	(0.97)
Household has a radio	0.003	0.003	0.003	-0.001	-0.001
	(0.74)	(0.80)	(0.78)	(0.28)	(0.29)
House being pucca	0.006	0.004	0.004	-0.004	-0.002
	(1.00)	(0.70)	(0.72)	(0.78)	(0.52)
House being semi-pucca	0.006	0.004	0.004	-0.001	-0.001
	(1.09)	(0.73)	(0.74)	(0.28)	(0.15)
Travel time to school from home	0.000	-0.000	-0.000	-0.000	-0.000
	(0.10)	(0.48)	(0.62)	(1.28)	(1.03)
Schooling history					
Had pre-primary (maktab) education in childhood	0.018	0.018	0.017	0.007	0.009
	(4.25)**	(4.16)**	(3.91)**	(1.98)*	(2.54)*
Class rank in grade 7	-0.001	-0.001	-0.001	-0.001	-0.001
	(10.50)**	(9.85)**	(10.48)**	(12.91)**	(12.46)**
Attended primary private school	-0.008	-0.008	-0.008	-0.012	-0.013
	(1.52)	(1.60)	(1.60)	(3.18)**	(3.30)**
Attended primary madrasa	-0.027	-0.029	-0.037	-0.012	-0.012
	(2.47)*	(2.90)**	(3.21)**	(1.58)	(1.52)
Attended primary NGO school	0.006	0.001	0.000	-0.013	-0.013
	(0.72)	(0.16)	(0.06)	(2.02)*	(1.99)*
Attended primary grade in this school	-0.003	-0.000	-0.007	-0.007	-0.007
	(0.29)	(0.01)	(0.64)	(0.73)	(0.71)
Secondary school attributes					

Madrasa	-0.039	-0.019	0.002		
	(5.95)**	(2.45)*	(0.21)		
Class size		0.000	0.000	0.001	
		(1.90)+	(2.91)**	(4.28)**	
School's distance to the nearest secondary school		-0.002	-0.002		
		(0.98)	(0.73)		
School expenditure (in logs)		0.005	0.004		
		(1.86)+	(1.53)		
Years to recognition		-0.001	-0.001		
		(4.04)**	(4.42)**		
School received "best performance award"		0.021	0.020		
		(2.99)**	(2.78)**		
Fraction of teachers being female		0.174	0.186		
		(8.92)**	(9.02)**		
Fraction of teachers being trained		0.004	0.016		
		(0.42)	(1.41)		
Single-sex school		-0.010	-0.009		
		(1.48)	(1.32)		
Constant	0.324	0.214	---	0.355	0.432
	(7.07)**	(3.05)**	---	(7.43)**	(9.81)**
N	7710	7710	7710	7710	7710
R^2	0.04	0.05	0.05	0.04	0.04
Partial R^2 of excluded instruments	---	---	0.49	---	---
F test of excluded instruments (p-value)	---	---	0.00	---	---
Sargan over-identification test (p-value)	---	---	0.64	---	---

Note: Absolute value of t statistics in parentheses. + significant at 10%; * significant at 5%; ** significant at 1%. Excluded instruments are "# of times father pray daily" and "mean class-size of other schools in the PSU". Each regression additionally contains a set of 5 dummies indicating which day of the week the test was taken.

While the purpose of this paper is to evaluate the relative performance of secular and religious schools, the determinants of sector selection are interesting in their own right[12]. We find that the signs on the coefficients in the sector-selection equations (i.e. first stage regressions) are consistent with our priors. Father's religiosity, measured by the frequency of prayers, positively predicts selection into a religious school. On the other hand, larger class size by other secular schools in the PSU increases the probability of enrolment in a religious school. The later result is also shared by Figlio and Stone (2000) who use characteristics of local public schools to model selection into private schools in the US. They find that parents are more likely to send their children to *public* schools if the *private sector* student-teacher ratio in the county is higher.

The first stage results show that our instruments are strong. The excluded instruments, parental religiosity and characteristics of the local secular school, are individually significant. They also pass the over-identification test at the conventional level. The Sargan overidentification test cannot be rejected at the 5% level in any model. That is, the instruments pass the exogeneity test. We also experimented with alternative tests of overidentification, namely the Anderson-Rubin overidentification test. Once again, this cannot be rejected at the 5% level in any model.

[12] Results of the first stage regressions are not reported but available from the authors upon request.

There are some striking changes in the regression estimates once we control for endogeneity of selection into religious schools using the detailed specification. The coefficient on the madrasa dummy is now insignificant. However, the positive effect of female teachers and the (significantly) negative effect of primary madrasa education remain significant. On the basis of regional FEs-IV estimates, it can therefore be concluded that allowing for the endogeneity of religious school attendance, students of religious and secular students do not differ in terms of their performance in secondary level mathematics test. This result whilst contrary to popular belief is not entirely unsurprising: Beegle and Newhouse (2005) report similar results using Indonesian data.

In summary, the regional FE estimates of religious (secondary) school attendance reveal a significant effect which weakens once we control for various observed characteristics of the school (Table 2, column 2). But it disappears once we additionally correct for the endogeneity of enrolment in a religious school (Table 2, column 3). Our strategy to identify selection into religious school needs some qualifications, however. As pointed out earlier, our choice of parental religiosity as an exogenous source of variation in school choice follows the US literature. A large number of studies using US data have employed religious affiliation and the proximity to Catholic (religious) schools for identifying the effect of Catholic schooling. However, Altonji et al. (2005) questions the candidacy of these variables as instruments for the US datasets. Whilst no evaluation of the goodness of these instruments is available on developing countries, caution is needed in using these variables as a useful source of identification. This is despite favorable results emanating from our statistical tests of instrument validity and relevance. We re-estimated the regressions excluding religiosity as an instrument. Whilst our results go through, we cannot test the validity of the remaining instrument for our model becomes exactly identified.

The second source of identification in our data relates to the attributes of un-chosen schools in the residential locality. This could be problematic for the following reason. Local school attributes could potentially proxy for competitive environment in which schools operate. For instance, schools located in PSUs with more madrasas and schools are likely to be more competitive. When parents can choose schools, schools may respond by hiring and keeping teachers who help them attract students. Thus, the very prospect of parental choice may affect school quality via bolstering competition. However, we argue that this does not undermine the exogeneity of our instruments as we partially control for the degree of school competition via including PSU dummies. The estimates of production function reported in Table 2 are identified on the basis of within PSU variation in school inputs so that all schools face the same degree of competition.

Lastly, the regional FE-IV estimates discussed above may be criticized on the ground that they do not fully rule out selection into secular/religious schools when more than one school of each type is available in the vicinity within a PSU. To account for this problem, we re-estimate our model controlling for school fixed-effects. This specification exploits the fact that we have collected data on all students in a classroom in grade 8 and 10% of our sample schools have multiple classrooms in grade 8. Therefore, by controlling for school fixed effects, we are able to

examine the causal influence of inputs such as class size that varies within the school[13]. Most importantly, this strategy yields cleaner estimates of the type of primary school attended by the students.

Results are summarised in column 4 of Table 2. All variables that are invariant within school have now dropped out from the regression model. Some interesting results are discernible nevertheless. First, primary education in a NGO school has a significant negative effect on secondary school test score. Being educated in a primary madrasa still has a negative effect, however, the significance is reduced to the 11% level. Second, pre-primary schooling still has a small positive effect. Third, class rank in the previous grade final examination continues to exert a significant effect: students who academically ranked low amongst their in the previous grade performs poorly compared to their peers with superior ranking. Fourth, female students have significantly lower test score compared to their male peers. Lastly, class size still has a perverse positive and significant effect. This result is counter-intuitive but not entirely at odds with other extant studies on class size (for instance, see Asadullah (2005b) and Wößmann and West (2006)). Column 5 of Table 2 reports estimates of past school input variables controlling for classroom fixed effects. Reassuringly, estimated impacts of gender and religious primary school attendance are similar to that obtained from school FEs model.

6. Conclusion

Our purpose in this study has been to investigate student performance of religious and secular secondary schools in Bangladesh, relying upon uniquely detailed data and model specifications. In doing so, we have contributed to the literature in several ways. First, ours is the first study on the relative quality of religious secondary schools for a developing country. Second, we offer a principal innovation to the literature comparing religious and secular schools by directly modeling selection into religious schools. The unique design of our survey allows us to minimize the problems of non-random selection into schools in a fixed-effect framework. Our analysis is based on a survey where all schools in a given catchment area were covered. This led to a near-census of students currently enrolled in secondary school in the study area and permitted estimation of "catchment area" fixed effects models of educational production function where school-specific inputs were arguably less endogenous. Most importantly, our identification strategy uses data on the characteristics of local secular school alternatives to a religious school to explicitly model selection into madrasas. Third, we additionally estimate school and classroom fixed effects models of educational production function and report estimates of the impact of madrasa attendance for primary education.

Several important findings emanate from our study on learning outcomes in rural secondary schools in Bangladesh. First, we find that girls have a lower test score compared to boys, all else equal. Second, school type matters – pupils who attend secondary religious schools are worse off compared to their secular schooled peers. But once the decision to attend a religious school is treated as endogenous, no difference in test score prevails between religious and secular school students. Third, madrasa attendance for primary education, however, exerts a (marginally)

[13] For a similar application of school fixed effects technique in the estimation of educational production functions, see Wößmann and West (2006).

significant negative effect on test score even after accounting for school-specific unobservable determinants of learning.

To conclude, future research should investigate factors that can assist in improving school quality and closing the existing gender gap. Precisely how quality of secondary and their feeder (primary) schools could be improved is not clear. One important policy intervention is the employment of female teachers. Our data suggests that exposure to female teachers bolster test score. Given the positive influence of female teachers on female student performance, the current government initiatives to recruit more female teachers can also significantly narrow the boy-girl difference in test score[14]. Lastly, we have not accounted for the option of non-formal religious education in the rural area. A large number of madrasas in Bangladesh and elsewhere in South Asia follow traditional curriculum which exclusively educate children in religious matters. Future studies on religious schools should distinguish between modern and traditional types and assess their competitive position in relation to other non-faith schools.

[14] Dee (2005) makes a similar argument using US data. He documents gender difference in test score by subjects - girls outperform boys in measures of reading achievement while generally underperforming in mathematics. He attribute this finding to the possibility that assignment to an opposite gender teacher lowers student achievement by at least 0.042 standard deviations for the US data.

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