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DO CROWDED CLASSROOMS CROWD OUT LEARNING? EVIDENCE FROM THE FOOD FOR EDUCATION PROGRAM IN BANGLADESH

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Abstract

In Bangladesh, pervasive poverty has kept generations of families from sending their children to school, and without education, their children's future will be a distressing echo of their own. Many children from poor families in Bangladesh do not attend school either because their families cannot afford books and other school materials, or because the children contribute to their family's livelihood and cannot be spared. In some areas, there is also a lack of schools. Among those who enter primary school, only about 40 percent of them complete it. The commendable success of the Food for Education (FFE) program of the Government of Bangladesh has led to larger classes, but do these crowded classrooms crowd out learning?

How does FFE work?

The Government of Bangladesh launched the FFE program in 1993. The FFE program provided a free monthly ration of foodgrains to poor families in rural areas if their children enrolled in primary school, and maintained an 85 percent attendance rate. The family could consume the grain or sell it and use the cash to meet other expenses. Before the program was terminated in June 2002, the FFE program covered about 27 percent of all primary schools and enrolled about one-third of all primary school students. FFE beneficiary students accounted for about 13 percent of all students in primary schools in Bangladesh. The cost of the program (including the value of foodgrains) was approximately US$37 per beneficiary student per year. A two-step targeting mechanism was used, selecting poor areas, then poor households within those areas.

Data from school and household surveys conducted in Bangladesh by the International Food Policy Research Institute (IFPRI) in September-October 2000 were used to evaluate the FFE program. The surveys included primary schools with and without the FFE program, and a cross section of households including program beneficiaries and nonbeneficiaries. The sample includes 600 households in 60 villages in 30 unions in 10 *thanas*, and 110 schools in the same 30 unions from which the household

sample was drawn. In addition, a standard academic achievement test, designed to assess the quality of education received by students, was given to students in both FFE and non-FFE schools.

What was the impact of FFE on learning?

IFPRI analysis showed that the FFE program led to increased enrollment and class attendance rates, particularly among girls. However, classrooms of FFE schools became more crowded: on average, classrooms in FFE schools had 22 percent more students (67 students) than classrooms in non-FFE schools (55 students). Within FFE schools, the average test score is lower for FFE beneficiaries than nonbeneficiary students, which brings down the aggregate score in FFE schools. In non-FFE schools, average test scores of all students are comparable to nonbeneficiaries in FFE schools. Boys consistently outperformed girls in the achievement test in all subjects in all types of schools, regardless of FFE beneficiary status.

Does classroom crowding (resource dilution) or the lower ability of FFE children (peer effect) affect test scores of non-FFE students in FFE schools? IFPRI's multivariate analysis does not support the resource dilution hypothesis. Class size has no effect on student achievement.

Results of the peer effect analysis, however, show that the learning performance of non-FFE students in FFE schools is negatively affected when an average of 44 percent of the students in class are FFE beneficiaries. This is probably due to the teachers having to go more slowly to accommodate poorly performing FFE students. These students come from poorer families. Evidence from household surveys show that children from poor families are less likely to have educated parents who could help them in their studies at home, afford study materials, and find enough time to do the homework, as many of them must contribute to their family's livelihood. Moreover, from birth, these children are often deprived of the basic nutritional building blocks that they need in order to learn.

Nevertheless, there are benefits to non-FFE beneficiaries from being in an FFE school because FFE schools must meet certain minimum educational quality standards to

maintain FFE eligibility. For example, in FFE schools, at least 10 percent of Grade 5 students must qualify for the national annual scholarship examination. No such performance standards are required for the non-FFE primary schools. These benefits to non-FFE beneficiaries outweigh the negative peer effects up to the point when FFE beneficiaries reached 69 percent of the students in the classroom. After 69 percent, the benefits derived from minimum performance standards vanish.

The overall effect at the community level is measured by the Minimum Learning Achievement; the percentage of children in a community who attain a minimum achievement score, weighted by the enrolment rate in that community. The minimum learning achievement in FFE communities is higher than in non-FFE communities (despite the latter tending to be richer) due to the increased enrollment from FFE. Particularly, major benefits accrued to the children from poor families who would not have attended school without the FFE program.

Implications for food assistance programming

As a food-based social safety net, the FFE program in Bangladesh served a wider purpose than simply providing the poor with immediate sustenance through take-home food rations, important as that is. It has empowered children from poor families with education, thereby paving their pathway out of poverty.

The FFE enrollment increase was greater for girls than boys, yet boys consistently outperformed girls on the achievement tests. Having drawn them into school, improving the quality of girls' education will ultimately strengthen the beneficial effects of women's education on various family-level outcomes, such as children's schooling, child health and nutrition, and women's fertility.

The concern that learning performance of non-FFE students in FFE schools may be adversely affected by increased class size generated by the FFE program appears to be unfounded. But unchecked, the negative peer effect could hinder student achievement. In the FFE program, this was offset by the requirement that FFE schools must meet certain minimum educational quality standards in order to maintain their school-level

eligibility for the program. Setting clear standards for performance is important, even at the primary level. Minimum performance standards should be incorporated in the design of the recently implemented Primary Education Stipend program (a cash-for-education program that has replaced the government's FFE program), as well as in the ongoing pilot testing of the school-feeding program launched by the Government of Bangladesh with support from the World Food Programme.

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1. Introduction

It is hard to overemphasize the importance of quality education for improving the welfare of individuals. In developing countries, providing universal primary education connotes a great opportunity to reduce poverty and to promote economic growth. Quality primary education would equip children from poor families with literacy, numeracy, and basic problem-solving skills to move out of poverty.

In Bangladesh, pervasive poverty has kept generations of families from sending their children to school, and without education, their children's future will be a distressing echo of their own. Many children from poor families in Bangladesh do not attend school either because their families cannot afford books, other school materials, or clothes, or because the children contribute to their family's livelihood and cannot be spared. Among those who enter primary school, only about 40 percent of them complete it.

In an effort to increase primary school enrollment of children from poor families and to retain them in school, the Government of Bangladesh launched the Food for Education (FFE) program in 1993. The FFE program provides a free monthly ration of foodgrains to poor families in rural areas if their children attend primary school. Thus, the FFE foodgrain ration becomes a monthly income entitlement enabling a child from a poor family to go to school. The family can consume the grain, thus reducing its food budget, or it can sell the grain and use the cash to meet other expenses.[1]

A recent evaluation of the Bangladesh's FFE program, conducted by the International Food Policy Research Institute (IFPRI), finds that the program has largely fulfilled its objectives of increasing school enrollment, promoting school attendance, and preventing dropouts. The enrollment increase was greater for girls than for boys. The

[1] In June 2002, the Government of Bangladesh terminated the FFE program, and replaced it with the Primary Education Stipend program—a cash-for-education program.

study also finds that the program significantly increases food consumption in the beneficiary households (Ahmed and del Ninno 2002).

There have been a number of other studies that estimated the impact of the FFE program on primary school enrollment in Bangladesh. They all suggest that the program has resulted in increased primary school enrollment (Ahmed 2000; Ahmed and Billah 1994; Arends-Kuenning and Amin 2000; BIDS 1997; DPC 2000; Khandker 1996; Ravallion and Wodon 1997). However, because of increased enrollment and class attendance rates, FFE school classrooms are more crowded than non-FFE school classrooms. Consequently, there have been concerns about the deterioration of the quality of education in FFE schools.

In this paper, we examine whether the FFE program has lowered the academic performance of the students attending FFE schools. The paper is organized as follows. Section 2 puts our research issue in perspective by reviewing literature on the effect of classroom size on learning. Section 3 provides an overview of the FFE program. Section 4 discusses the data that are used in our empirical work. Section 5 contains the findings of our empirical analysis. We then present our conclusions in Section 6.

2. Review of Literature on the Issue

In this section we review the state of knowledge about the effects of class size on student achievement. Currently, a very active debate is occurring in the economics of education literature on the question of whether large class sizes have a negative impact on student learning. On one side, Hanushek (2003) makes the argument that few published studies have found the expected negative and significant impact of class size on student learning, indicating that school resources are not utilized well. Hanushek (2003) notes that of 276 published U.S. estimates, 14 percent found positive and statistically significant impacts of teacher/pupil ratios on student performance, but an equal percentage found negative and statistically significant impacts. Seventy-two percent of the estimates found statistically insignificant effects. In developing countries, Hanushek

reviewed 30 estimates, of which an equal percentage, 27 percent, found positive and significant effects of the teacher/pupil ratio on student achievement, as found negative and significant effects.

On the other side of the class size debate, researchers argue that most published studies are seriously flawed and therefore, one should focus attention on the few well-designed studies in the literature. Krueger (2002) argues that if one analyzes the published studies, giving more weight to the well-designed studies, class size has a significant and negative impact on achievement test scores. Glewwe (2002) is highly critical of conventional studies of the impact of class size on student achievement test scores. He points out that most studies do not properly control for the unobserved characteristics that influence class size and achievement. For example, governments might provide more resources in areas that have low schooling attainment compared to areas with high schooling attainment. In this case, regression analysis that did not control for the government's resource allocation might find that larger class sizes are associated with higher school achievement. Glewwe cites two well-designed studies in South Africa (Case and Deaton 1999) and in Israel (Angrist and Lavy 1999) that both find significant positive impacts of smaller class sizes on student achievement.

There are, however, reasons why smaller class sizes might not be associated with higher achievement test scores. Lazear (1999) argues that what matters to classroom performance is the number of disruptions. As class size increases, the probability that a disruption will occur tends to increase, other things being equal. However, disruptive students might be placed in smaller sized classes, in an effort to monitor their behavior. Hanushek (2003) interprets data from the STAR project, an experiment in the U.S. state of Tennessee, where school children were randomly assigned to classes with varying size, as showing that there is a one-time benefit to small class sizes in kindergarten, which probably represents a socialization effect. Once students are socialized to behave properly in school, there is little benefit to small class sizes.

In a study on determinants of primary education quality in Francophone Africa, Michaelowa (2001) finds a positive effect on of the number of students in each class on

student achievement up to a class size of 62 students. Above this size, however, the effect becomes increasingly negative. Michaelowa then cites Hanushek (1998), and Mingat and Suchaut (1998) who find that, below a certain limit, an increase in class size would not lower student achievement.

3. Overview of the FFE Program

Origin of the FFE Program

In 1992, the Government of Bangladesh closed down the *Palli* (rural) Rationing program, one of the largest channels in the Public Food Distribution System (PFDS). The government was providing subsidies equivalent to US$60 million per year to run the program. However, about 70 percent of the subsidized foodgrain (mostly rice) was going to those who were not poor, i.e., ineligible to receive the subsidy (Ahmed 1992). The high cost of subsidy and heavy leakage to the nonpoor motivated its abolition.

Following the demise of *Palli* Rationing, the government commissioned a working group, chaired by IFPRI, to review the options for developing food programs that would reach the neediest people in a cost-effective manner. Drawing on the working group's suggestions, the government launched a large-innovative pilot program, Food for Education, in July 1993.

Expansion of the FFE Program in Relation to Overall Primary Education

Table 1 shows the trends in primary education in Bangladesh during the 10 years from 1989/90 to 1998/99. Over this period, the number of primary schools increased by 43 percent; teachers employed in primary schools, by 39 percent; and students in primary schools, by 59 percent. Almost the entire expansion in primary education during the period was due to the growth in private-sector schools. There was a sudden and big surge in the number of nongovernment primary schools, which increased from 13,043 in

1992/93 to 28,640 in 1993/94. This increase was in response to a new government directive that provided incentives to rural communities to build new schools.

Table 1 Number of government and nongovernment primary schools, teachers, and students

Year	Number of schools			Number of teachers			Number of students		
	Government	Non-government	Total	Government	Non-government	Total	Government	Non-government	Total
							(thousands)		
1989/90	37,760	8,023	45,783	162,237	37,819	200,056	10,494	1,851	12,345
1990/91	37,659	10,487	48,146	160,744	42,103	202,847	10,722	2,313	13,035
1991/92	38,097	11,867	49,964	158,180	50,091	208,271	11,157	2,560	13,717
1992/93	37,855	13,043	50,898	160,497	54,282	214,779	11,239	2,963	14,202
1993/94	37,528	28,640	66,168	159,538	82,714	242,252	11,266	3,919	15,185
1994/95	37,717	24,900	62,617	161,251	87,532	248,783	11,826	4,603	16,429
1995/96	37,752	23,831	61,583	161,026	88,689	249,715	12,026	5,042	17,068
1996/97	37,348	24,290	61,638	161,597	88,331	249,928	12,248	5,071	17,319
1997/98	41,248	24,987	66,235	160,677	90,313	250,990	12,423	5,206	17,629
1998/99	39,709	25,901	65,610	179,710	99,282	278,992	13,521	6,091	19,612

Source: Bangladesh Bureau of Statistics (BBS). "Statistical Yearbook of Bangladesh," various issues.

Note: Nongovernment schools include (1) registered nongovernment primary school, (2) high school-attached primary school, (3) experimental school, (4) Ebtadayee Madrasa (EM), (5) high madrasa attached EM, (6) kindergarten school, (7) satellite school, and (8) community school.

Data in Table 1 also indicate that the average number of students per teacher in all primary schools increased from 62 in 1989/90 to 70 in 1998/99. There are more students per teacher in government schools than in nongovernment schools. In 1989/90, government schools had a student/teacher ratio of 65, while in nongovernment schools the ratio was 49. This ratio increased to 75 for government schools and 61 for nongovernment schools in 1998/99.

The FFE program started in 1993 in 460 unions, one union in each of the 460 rural *thanas* in Bangladesh.[2] The program expanded to 1,247 unions by 2000. From

[2] The administrative structure of Bangladesh consists of divisions, districts, *thanas*, and unions, in decreasing order by size. There are five divisions, 64 districts, 489 *thanas* (of which 29 are in four city corporations), and 4,451 unions (all rural). The FFE program was implemented in all 460 rural *thanas*.

1993/94 to 1999/00, the number of primary schools covered by the program increased by 262 percent and the number of students in the program schools increased by 245 percent. About 40 percent of the students in FFE schools received FFE foodgrains. Hence, out of the 5.2 million students enrolled in schools with the FFE program in 2000, 2.1 million students were FFE beneficiaries. About 2 million families benefited from the program in 2000. Before the program was terminated in June 2002, FFE had covered about 27 percent of all primary schools and enrolled about one-third of all primary school students in Bangladesh. FFE beneficiary students accounted for about 13 percent of all students in primary schools.

In 1993/94, the FFE program started at a cost of 683 million taka (US$17 million),[3] involving distribution of 79,553 metric tons of foodgrains. By 1999/00, the annual cost increased to 3.94 billion taka (US$77 million), and the distribution of foodgrains to 285,973 metric tons. The cost of the program (including the value of foodgrains) in 2000 translates into 1,897 taka (US$37.19) per beneficiary student per year. The share of the FFE program in total expenditure for primary education in the country increased from 4.7 percent in 1993/94 to 19.9 percent in 1997/98.

Salient Features of the FFE Program

The FFE program was funded by the Government of Bangladesh. The program was one of the foodgrain distribution channels of PFDS and was administered by the Primary and Mass Education Division (PMED).

The FFE program used a two-step targeting mechanism. First, two to three unions that were economically backward and had a low literacy rate were selected from each of the 460 rural *thanas*. The program covered all government, registered nongovernment, community (low-cost), and satellite primary schools, and one *Ebtedayee Madrasa* (religion-based primary school) in these selected unions. Second, within each

[3] The official exchange rate for the taka, the currency of Bangladesh, was 40.25 taka per US$1.00 in June 1994. The exchange rate was 51.00 taka per $1.00 in June 2000.

union, households with primary-school-age children became eligible for FFE benefits if they met at least one of the following four targeting criteria:

1. A landless or near-landless household that owns less than half an acre of land;
2. The household head's principal occupation is day laborer;
3. The head of household is a female (widowed, separated from husband, divorced, or having a disabled husband); or
4. The household earns its living from low-income professions (such as, fishing, pottery, weaving, blacksmithing, and cobbling).

A household that met the targeting criteria, but was covered under another targeted food-based program of the government (such as the Vulnerable Group Development program or the Rural Development program), was not eligible to receive FFE foodgrains.

If a household was selected to participate in the FFE program, it was entitled to receive a free ration of up to 20 kilograms of wheat or 16 kilograms of rice per month for sending its children to a primary school.[4] If a household had only one primary-school-age child (6-10 years) who attended school, then that household was entitled to receive 15 kilograms of wheat or 12 kilograms of rice per month. To be eligible for 20 kilograms of wheat or 16 kilograms of rice, a household was required to send more than one child, and all primary-school-age children, to school. To maintain their eligibility, children had to attend 85 percent of total classes in a month. Thus, the total foodgrain allotment to a school could vary from month to month, depending on the variation in the number of students who met the attendance requirement.

Based on the targeting criteria, a School Managing Committee (SMC) and a Compulsory Primary Education Ward Committee jointly prepared a list of FFE beneficiary households in every union at the beginning of each year. Due to resource

[4] Of the total quantity of FFE foodgrain distributed from 1997/98 to1999/00, wheat accounted for about 64 percent, and rice, about 36 percent.

constraints, the total number of beneficiary households was identified so that no more than 40 percent of students received FFE rations. The beneficiary list was recorded in a registry book. The headmaster of the school, who was a member and secretary of the SMC, was the custodian of this registry book. Each FFE-enlisted household received a ration card that entitled it to receive the monthly free foodgrain ration.

In the beginning of each month, the headmaster prepared a list of students from beneficiary households who had met the 85 percent attendance requirement in the previous month. Based on this list, the SMC calculated the foodgrain requirement for the school for that month and prepared a procurement request. The *Thana* Education Officer certified the procurement request and then forwarded it to the *Thana* Controller of Food, an official of the Ministry of Food. Each union had a designated private grain dealer who distributed FFE foodgrains to all beneficiary households in that union. Based on the procurement requests, the *Thana* Controller of Food issued a delivery order to the Ministry of Food's Local Supply Depot to provide all grain dealers in the *thana* with monthly supplies of FFE foodgrains for distribution to all beneficiary households living in that *thana*. Each beneficiary student's parent or guardian holding the FFE ration card picked up the monthly ration on a day specified by the school. Designated officials were responsible to supervise the foodgrain distribution (PMED 2000).

4. Data

Our data come from school and household surveys conducted in Bangladesh by IFPRI in September-October 2000 for an evaluation of the FFE program. The surveys included primary schools with and without the FFE program, and a cross section of households including program beneficiaries and nonbeneficiaries.

The sample includes 600 households in 60 villages in 30 unions in 10 *thanas*, and 110 schools in the same 30 unions from which the household sample was drawn. First, the sampling process randomly selected 10 *thanas* with probability proportional to size (PPS), based on *thana*-level population data from the 1991 census. Second, two FFE

unions and one non-FFE union were randomly selected per *thana*. Third, two villages from each union were randomly selected with PPS using village-level population data from the 1991 census. A complete census of the households was carried out in each of the selected villages. Then, 10 households that had at least one primary-school-age child (6 to 12 years old) were randomly selected in each village from the census list of households.

Only those schools attended by the children in the sample households were selected for the school survey. A total of 110 primary schools (70 FFE and 40 non-FFE schools) were surveyed.

Several questionnaires were used to survey primary schools with and without the FFE program, a cross section of households including program beneficiaries and nonbeneficiaries, FFE foodgrain dealers, program implementing officials, and FFE and non-FFE communities. In addition, a village census questionnaire collected information on household demography, school enrollment, literacy, and FFE participation from 17,134 households.

The household questionnaire collected information on a wide variety of topics, such as household composition, occupation, education, school participation, dwelling characteristics, assets, expenditures, food consumption, anthropometric measurements of women and children, and use of the FFE system. A team of male and female interviewers, who completed separate male and female questionnaires for each household, administered the household survey.

The school questionnaire collected information on student enrollment, class attendance, dropout and repetition, teacher qualification, school facilities, physical characteristics, school expenditures, and FFE program participation.

Questionnaires administered to foodgrain dealers and program-implementing officials captured various operational aspects of the FFE program. A community survey was conducted in all sample villages to collect primary data on union-level and village-level variables.

In addition to the above-mentioned surveys, the data include children's academic achievement test scores. Two sets of test scores are available. The test was administered twice—once to 3,369 fourth-grade students[5] attending the 110 surveyed FFE and non-FFE schools, and separately to a subsample of 288 children in the household. Unfortunately, it was difficult to locate a larger number of children in their households who could take the test.

The test was a standard academic achievement test, designed to assess the quality of education received by students. The household sample of test score data is limited because of its small sample size, but it relates to detailed information collected in the household survey. The school sample test score data has the advantage of a large sample that relates to school characteristics from the school survey, but lacks information on students' socioeconomic background. However, the school test score data can be combined with community data and aggregate data from the household survey to control somewhat for socioeconomic background. The test included four subjects—Bangla, English, mathematics, and environmental awareness. The test was developed by an expert from the Institution of Education and Research at the University of Dhaka, and was reviewed by researchers from the Bangladesh Institute of Development Studies and IFPRI.

5. Analysis of Program Effects on Learning

In this section we address our research issue—the effects of the FFE program on learning. We first present the results of the school-level analysis, which is based on data collected in the school survey. We then provide our findings from the household-level analysis, using the household survey data.

[5] Primary education in Bangladesh includes Grades 1 to 5.

School-Level Analysis

General Information on Schools

Observations during the school survey suggest that, in general, nongovernment primary school buildings in rural Bangladesh are in much poorer condition than those of government primary schools. Only about 11 percent of the total sample of nongovernment schools have a permanent building structure of concrete or tin roofs, brick walls, and cement floors, compared to 45 percent of all surveyed government schools that have such a structure.

Table 2 indicates that the average size of FFE schools (in terms of number of students per school) is about 27 percent larger than that of non-FFE schools because the FFE program entices more children to attend schools. About half of all students are girls. The number of teachers per school (FFE and non-FFE, government and nongovernment) ranges from 3.9 to 4.7. Overall, about 3 out of 10 teachers are female.

Table 2 also shows that average annual school operating expenses per student (excluding teacher salaries) are generally low (around 40 taka per student a year), or very low (only 27 taka per student a year) for nongovernment FFE schools.[6] Both government and nongovernment schools under the FFE program are more intensively inspected than schools that are not in the program. Over 90 percent of teachers in both the FFE and non-FFE schools received training. More teachers in nongovernment schools are engaged in private tutoring compared to government schools, and this is true for both FFE and non-FFE schools.

Table 3 shows that the educational qualifications of teachers in FFE and non-FFE schools are about the same. However, teachers in government schools have higher education levels than nongovernment schoolteachers. About 32 percent of government

[6] School operating expenses exclude teacher salaries, and include the costs of stationery and supplies, repair and maintenance, utilities, and communication. Information on school expenses was not available for the non-FFE, nongovernment schools.

Table 2 General information, by type of schools

Information	FFE schools			Non-FFE schools		
	Government	Non-government	All	Government	Non-government	All
Number of students per school in 2000	350	315	343	286	162	270
Proportion of girls (percent of total)	50.0	50.0	50.0	50.0	48.3	49.9
Average number of teachers per school	4.7	3.9	4.5	4.4	4.0	4.4
Share of female teachers (percent of all teachers)	28.9	29.3	29.2	33.1	…	…
Average operating expenses per student (taka/year)*	43	27	40	41	…	…
Inspection made by school inspectors in 1999 (percent of schools)	100.0	92.9	98.6	88.6	80.0	87.5
Number of inspections in 1999	5.7	3.4	5.2	5.1	2.4	4.8
Fully follow curriculum (percent of schools)	94.6	92.9	94.3	91.4	100.0	92.5
Teachers who received subcluster training (percent of schools)	94.3	90.9	93.7	98.1	100.0	98.3
Teachers engaged in private tutoring (percent of teachers)	14.3	50.0	21.4	25.7	80.0	32.5

Source: Based on data from IFPRI's "Food for Education Evaluation Survey, 2000: School Survey," Bangladesh.

Note: Ellipsis (…) indicates information was not available. School operating expenses exclude teacher salaries, and include the costs of stationery and supplies, repair and maintenance, utilities, and communication.

schoolteachers have a bachelor's degree or above. In contrast, only 9.3 percent of all nongovernment schoolteachers have a bachelor's degree. There is almost no difference in teacher salaries between FFE and non-FFE schools. However, the average salary of a government schoolteacher is about 3.5 times higher than that of a nongovernment schoolteacher. Further, most nongovernment schoolteachers are not paid regularly. In all types of schools, each teacher teaches about four classes per day and five subjects per week.

Table 3 also indicates that, mainly due to much higher salaries, government schoolteachers are better-off than nongovernment schoolteachers, as reflected by the relative levels of monthly household expenditures. School salary accounts for about three-fourths of total income of government schoolteachers, whereas it accounts for only 27 percent of total income of nongovernment schoolteachers. Nongovernment schoolteachers mainly depend on agriculture for their livelihood, and are therefore less likely to devote themselves to teaching full-time.

Table 3 Information about teachers

Type of information	FFE schools			Non-FFE schools			All government	All non-government
	Government	Non-government	All	Government	Non-government	All		
Educational qualifications (percent of teachers)								
S.S.C.	37.4	43.6	38.5	34.2	55.0	36.5	36.2	46.7
H.S.C.	29.8	43.6	32.2	31.0	40.0	32.0	30.2	42.7
Other	1.5	10.9	24.6	28.4	5.0	25.7	27.8	9.3
Number of classes taught per day	3.9	-	3.2	5.2	-	4.5	4.3	-
		-	1.3	0.6	-	0.6	1.2	-
		4.2	4.0	4.0	4.4	4.1	4.0	4.3
Number of subjects taught	5.3	4.9	5.3	5.2	5.1	5.1	5.3	4.9
Monthly salary (taka)	4,519	1,279	3,960	4,306	1,300	3,960	4,439	1,285
Receive salary regularly (percent of teachers)	95.8	36.4	85.5	99.4	20.0	90.3	97.1	32.0
Monthly household expenditure (taka)	7,013	3,996	6,489	6,956	4,265	6,635	6,991	4,072
Source of income (percent of total income)								
School salary	74.8	29.1	66.9	69.0	20.0	63.4	72.7	26.7
Agriculture	12.2	56.4	19.9	18.1	75.0	24.6	14.4	61.3
Small business	1.9	7.3	2.8	1.3	-	1.1	1.7	5.3
Large business	1.1	3.6	1.6	1.3	5.0	1.7	1.2	4.0
Other	3.8	1.8	3.5	7.7	-	6.9	5.3	1.3

Source: Based on data from IFPRI's "Food for Education Evaluation Survey, 2000: School Survey," Bangladesh.

School-Level Effects on Learning

The main focus of our study is to assess the effects of FFE on learning. The relative quality of education in FFE and non-FFE schools could be judged on the basis of student/teacher ratio, number of students per classroom, and students' academic achievement test scores.

A large student-teacher ratio is often seen as detrimental to the quality of education. Since the inception of the FFE program in 1993, the number of teachers per school has remained virtually constant, while student enrollment has increased significantly in FFE schools. As a result, there are more students per teacher in FFE schools than in non-FFE schools. On average, whereas there were 61 students per teacher in non-FFE schools, FFE schools had 76 students per teacher in 2000. Of the nongovernment schools, FFE schools had 81 students per teacher, whereas those without the FFE program had only 41 students per teacher in 2000 (calculated from Table 2).

IFPRI's recent evaluation of the FFE program suggests that the overall rate of class attendance is 70 percent in FFE schools and only 58 percent in non-FFE schools (Ahmed and del Ninno 2002). Because of increased enrollment and class attendance rates, classrooms of FFE schools are more crowded than non-FFE school classrooms. Data in Table 4 indicate that, on the average, FFE school classrooms have about 22 percent more students than non-FFE school classrooms.

Table 4 Average class size: School survey results

	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5	All grades
			(Number of students per class)			
FFE schools	87	69	68	61	51	67
Government	87	69	69	62	54	68
Nongovernment	85	67	63	60	41	63
Non-FFE schools	70	60	55	48	43	55
Government	73	64	59	52	46	59
Nongovernment	47	35	31	26	23	32

Source: Based on data from IFPRI's "Food for Education Evaluation Survey, 2000: School Survey," Bangladesh.

To measure learning, we used the results of a standard academic achievement test that was administered to students. This test was given to all fourth-grade students in FFE and non-FFE schools, as explained in Section 2. Table 5 reports on the test scores. In general, high standards are maintained in Bangla, but test outcomes are disappointing for English. Students are intermediate performers in mathematics.

Table 5 shows that the average test scores are lower in FFE schools (49.1 percent of correct answers) than in non-FFE schools (52.0 percent of correct answers), and this difference is statistically significant. Within FFE schools, the average test score of FFE beneficiary students (45.6 percent of correct answers) is statistically significantly less than that of the nonbeneficiary students (53.2 percent of correct answers), which brings down the aggregate score in FFE schools. FFE beneficiaries score lower than nonbeneficiaries probably because of their relatively lower socioeconomic status.

Table 5 also shows that, the difference in test score is larger between government and nongovernment schools than that between FFE and non-FFE schools, with government school students performing better than nongovernment school students

(Table 5). Government primary schools have better facilities, have more qualified teachers, and provide higher incentives to teachers compared to nongovernment primary schools.

Table 5 Student achievement test scores at the fourth-grade level: School survey results

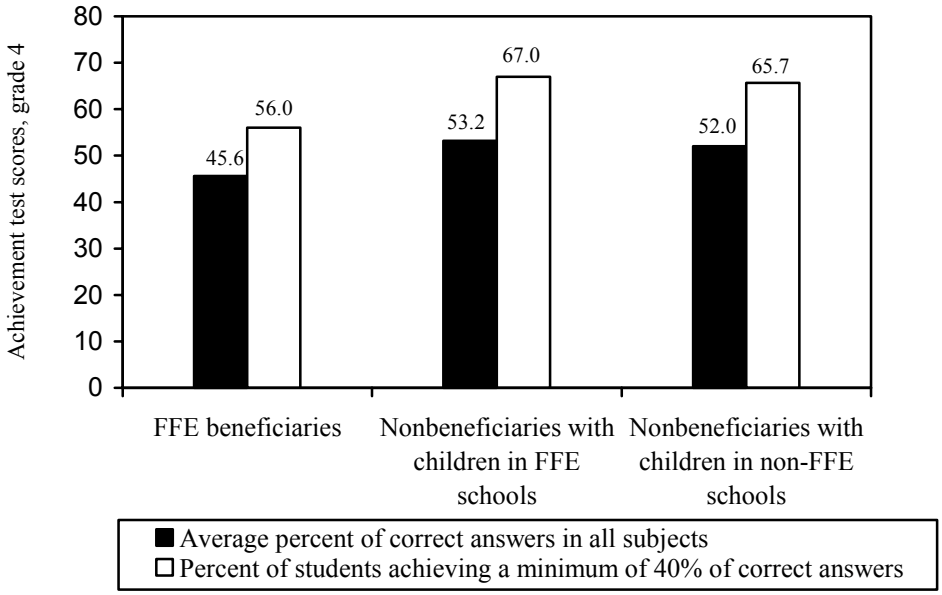
Type of school and program participation	Average rate of correct answers			
	Mean achievement in Bangla	Mean achievement in English	Mean achievement in Mathematics	Mean achievement in all subjects
	(Percent of correct answers)			
All FFE schools	67.6	27.9	47.3	49.1
Government schools	69.2	29.0	48.7	50.5
FFE beneficiary students	65.8	27.5	45.5	47.6
Nonbeneficiary students	72.7	30.6	52.2	53.5
Nongovernment schools	57.5	20.4	38.2	40.1
FFE beneficiary students	53.5	17.6	33.9	36.3
Nonbeneficiary students	67.8	27.7	49.4	49.9
All beneficiary students	63.6	25.7	43.4	45.6
All nonbeneficiaries in FFE schools	72.3	30.4	51.9	53.2
All Non-FFE schools	70.2	30.7	50.5	52.0
Government schools	70.3	31.3	51.7	52.7
Nongovernment schools	68.4	23.4	35.6	43.7
All nonbeneficiary students in all schools	71.4	30.5	51.3	52.7

Source: Based on data from IFPRI's "Food for Education Evaluation Survey, 2000: School Survey," Bangladesh.

Figure 1 illustrates the differences in student achievement between FFE beneficiaries and nonbeneficiaries. In addition to showing average rates of correct responses, Figure 1 also shows the share of children in each category scoring at least 40 percent of correct responses. The cutoff point of 40 percent is consistent with FFE policy. In 1998/99, in order to improve educational quality in FFE schools, the Government of Bangladesh imposed a number of requirements for the schools as well as the program beneficiaries to maintain their FFE status. One of these requirements is that students in Grades 3, 4, and 5 obtain at least 40 percent of total points on the previous year's annual examination.

Achievement test scores presented in Table 6 suggest that gender influences student achievement. Boys consistently outperformed girls in all subjects in all types of schools (government and nongovernment), regardless of FFE beneficiary status. The difference in test scores between all boys and all girls is statistically significant. Figure 2

Figure 1 Student achievement at the fourth-grade level



illustrates the differences in achievement between FFE beneficiary students and nonbeneficiary students, and between all boys and all girls, with girls showing lower achievement than boys in all cases.

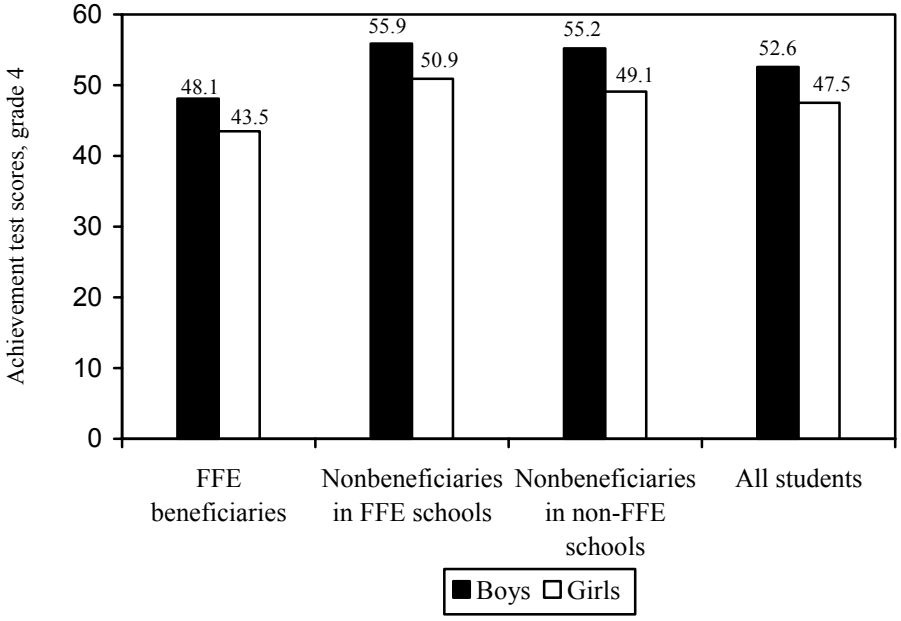
Do crowded classrooms reduce student achievement? If they do, then the concern that increased enrollment and attendance due to FFE compromise learning may be a valid

Table 6 Gender differences in achievement at the fourth-grade level: School survey results

Type of school and program participation	Mean achievement in Bangla		Mean achievement in English		Mean achievement in Mathematics		Mean achievement in all subjects	
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls
	(Percent of correct answers)							
FFE beneficiaries	64.3	62.9	28.6	23.2	47.1	40.1	48.1	43.5
All Nonbeneficiaries	73.3	69.8	32.9	28.5	55.6	47.7	55.6	50.2
Nonbeneficiaries in FFE schools	74.4	70.5	31.7	29.3	56.1	48.4	55.9	50.9
Nonbeneficiaries in Non-FFE schools	71.7	68.8	34.4	27.4	55.0	46.6	55.2	49.1
Government schools	70.8	68.3	32.1	27.4	53.6	46	53.8	48.7
Nongovernment schools	60.2	58.5	23.2	19.1	41.1	35.3	42.9	38.9
All students	69.6	67.0	31.1	26.4	52.2	44.6	52.6	47.5

Source: Based on data from IFPRI's "Food for Education Evaluation Survey, 2000: School Survey," Bangladesh.

Figure 2 Gender differences in achievement



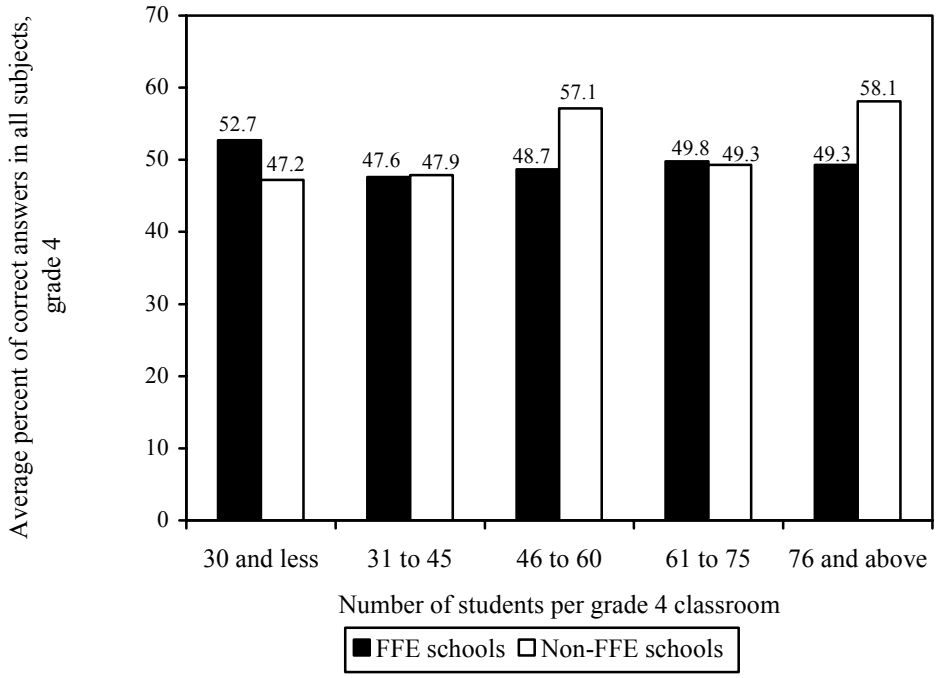
one. To observe whether there is such a relationship, we compare survey data on class size with achievement test scores in Figure 3. No negative correlation is apparent between fourth-grade class size and fourth-grade test scores. This is, however, a rather unrefined comparison in the sense that the effect of class size is not isolated from probable effects of other factors on achievement. In a multivariate framework in the later part of our paper, we attempt to control for such other factors, thereby measuring the true effect of crowded classrooms on student achievement.

Household-Level Analysis

Here we use household survey data including the results of achievement test given to children at their home to assess what household-level factors influence child academic achievement. As noted in Section 4, the sample of students who took the test at home is much smaller than the sample of students in the school survey. The sample of households was randomly drawn from the village census list of households with at least one primary-school-age child. We first present the characteristics of sample households

according to their place of residence in either FFE program or nonprogram unions. We then illustrate and discuss the results of our analysis of the effects of household-level factors on learning.

Figure 3 Class size and achievement, fourth grade



Profile of Survey Households

Table 7 presents the characteristics of households living in FFE and non-FFE unions, disaggregated by per capita expenditure quartiles.[7] In the FFE program unions, about half (52 percent) of all households with primary-school-age children are program

[7] Quartile groups are based on household quartiles ranked by total per capita expenditures. "Expenditure quartile" should be understood to mean households in any of the two strata—FFE unions and non-FFE unions. In this study, we use per capita expenditure as a proxy for income for two reasons. First, expenditures are likely to reflect permanent income and are, hence, a better indicator of consumption behavior (Friedman 1957). Second, data on expenditures are generally more reliable and stable than income data. Because expenditures are intended to proxy for income, the terms "expenditure" and "income" will be used interchangeably.

beneficiaries. The results presented in the first two rows in Table 7 indicate that the distribution of FFE beneficiaries is somewhat progressive. About 60 percent of the households in the poorest quartile (i.e., the bottom 25 percent of households in the income distribution) are program beneficiaries, compared to 37 percent of the households in the richest quartile that receive FFE benefits. However, this pattern also shows evidence of mistargeting, as many households in the higher income groups are included in the program. About 45 percent of all FFE beneficiary households belong to the richer half of all households.

Table 7 Characteristics of respondent households, by per capita expenditure quartile: Household survey results

	Per capita expenditure quartiles				Total
	1	2	3	4	
FFE unions					
FFE beneficiary households (percent)	60	53	57	37	52
Percent of all beneficiaries	29.0	25.6	27.5	17.9	100.0
Percent of households with primary-school-age children not going to school	19	17	7	8	13
Years of schooling, father	0.9	1.9	2.7	3.9	2.3
Years of schooling, mother	0.5	0.9	1.1	2.4	1.2
No schooling, adult male (percent)	66	59	53	36	54
No schooling, adult female (percent)	83	80	77	50	73
Per capita monthly expenditure (taka)	335	498	671	1,474	745
Non-FFE unions					
Percent of households with primary-school-age children not going to school	20	32	16	8	19
Years of schooling, father	0.8	1.6	3.3	5.0	2.7
Years of schooling, mother	0.2	0.9	1.5	3.7	1.6
No schooling, adult male (percent)	56	68	56	24	51
No schooling, adult female (percent)	92	80	76	36	71
Per capita monthly expenditure (taka)	356	521	728	1,597	800

Source: Based on data from IFPRI's "Food for Education Evaluation Survey, 2000: Household Survey," Bangladesh.

The results suggest that, for households with primary-school-age children in the first two quartiles (the bottom 50 percent of all households), about 36 percent in FFE unions and 52 percent in non-FFE unions do not send their children to school. Overall, about 13 percent of all households in FFE unions and 19 percent in non-FFE unions do

not send their children to school. This pattern could be an indication of the success of FFE in attracting children from poorer families to attend school.

The average years of parents' schooling are very low. Moreover, among the adult household members, over half of all adult males and almost three-quarters of all adult females never attended school. In both FFE and non-FFE unions, educational attainment of parents and other adults is positively correlated with income.

The FFE program was designed to target the most "economically backward" unions in each *thana*. As mentioned in Section 4, the FFE and non-FFE samples of unions were randomly drawn, respectively, from the lists of all FFE and non-FFE unions in a *thana*, rather than matching FFE and non-FFE unions on any characteristics. Therefore, we expect the FFE unions to be poorer than the non-FFE unions by design. A comparison of average household incomes (in terms of per capita expenditure) between FFE unions and non-FFE unions from Table 7 suggests that households in FFE unions are indeed somewhat poorer than households in non-FFE unions. The average household income in FFE unions is 6.9 percent lower than the average income in non-FFE unions, but this difference is not statistically significant.

Household-Level Effects on Student Achievement

Does a family's economic welfare affect child learning? Figure 4 portrays the relationship between per capita consumption expenditures (as a proxy for income) and achievement test scores of children from the same households. There is a positive correlation between the level of family income and child learning, and this relationship is more pronounced for households living in FFE unions. Children from families who are a part of the richest quartile scored 47 percent higher on the tests than the children from families who belong to the poorest quartile.

Figure 5 demonstrates that parental education also has an influence on achievement. Children with a parent who completed at least secondary school scored 56

Figure 4 Family income and child educational achievement

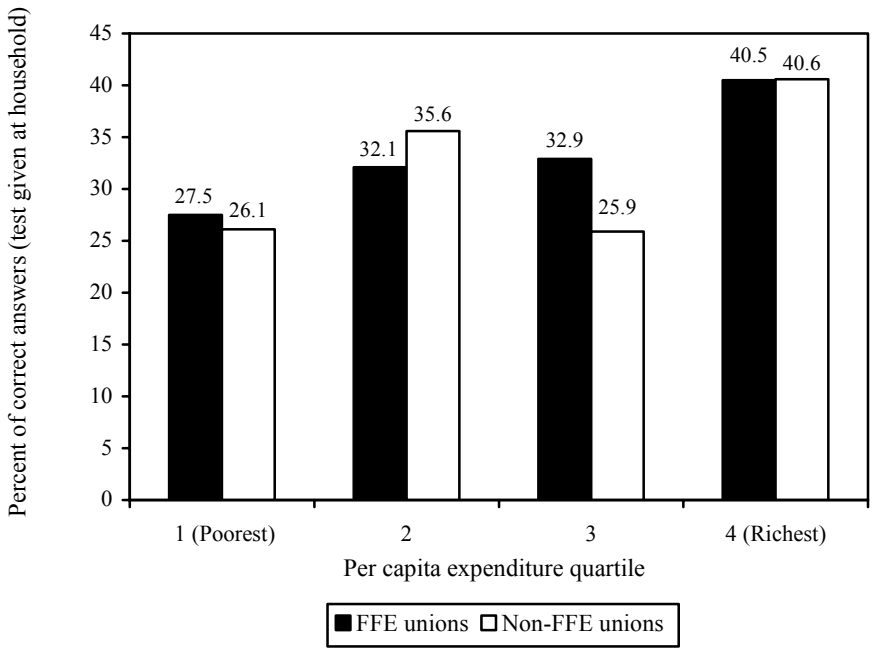
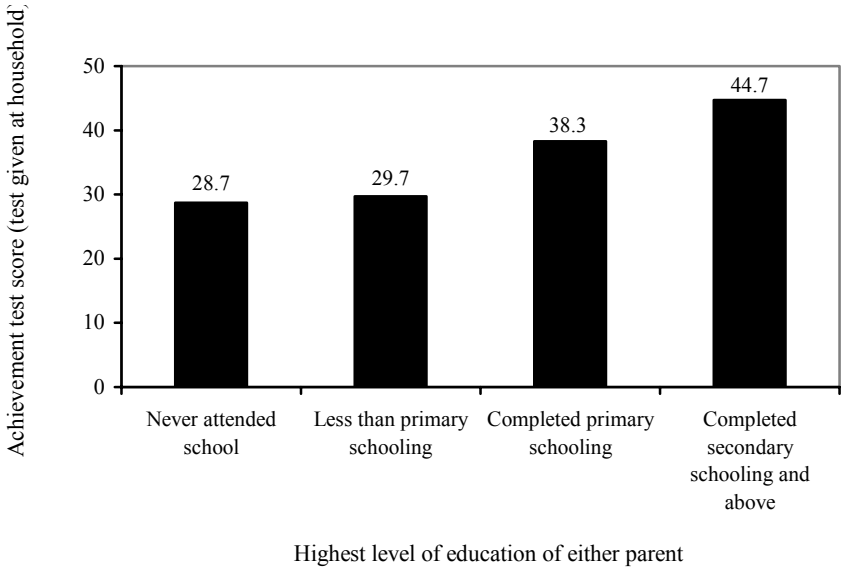


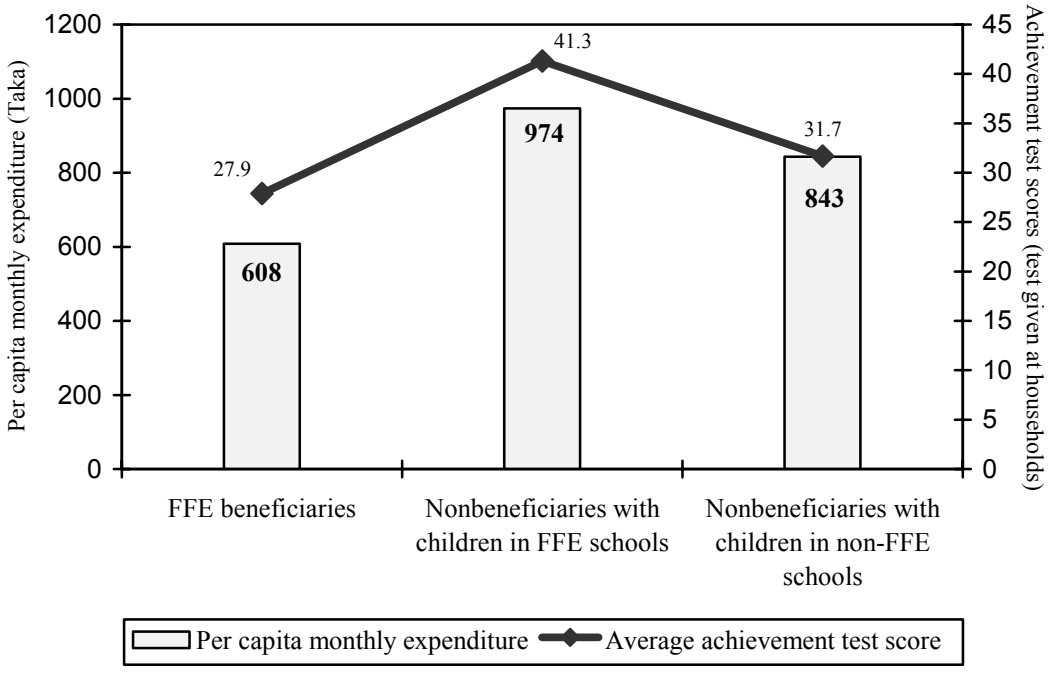
Figure 5 Highest level of education of either parent and child educational achievement



percent higher than children with parents who never attended school. Parents with higher educational attainment presumably place more importance on their children's education than the parents who acquired inadequate or no education.

The household survey results shown in Figure 6 suggest that the average monthly per capita expenditure of nonbeneficiary households with children attending FFE schools (974 per taka month) is 60 percent higher than that of FFE beneficiary households (608 taka per month).[8] This income difference is statistically significant. The average per capita expenditure of nonbeneficiary households living in non-FFE unions with school-going children (843 taka per month) is about 13 percent lower than that of nonbeneficiary households living in FFE unions. However, this difference is not statistically significant.

Figure 6 Income of FFE beneficiary and nonbeneficiary households, and child educational achievement



[8] Per capita monthly expenditures of FFE beneficiary households exclude the income transfer from the FFE program.

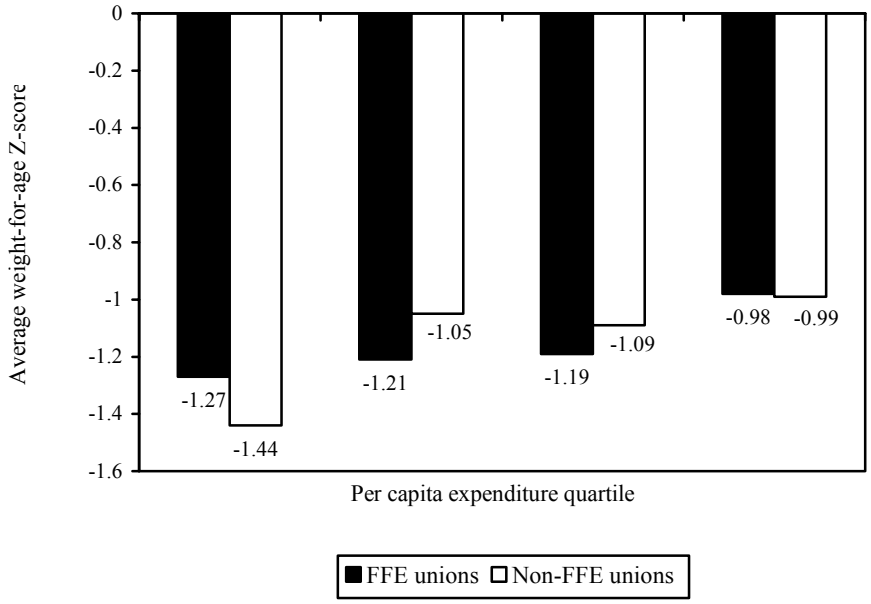
Our school-level analysis (with robust achievement test results from a large sample) above suggests that the average test score of FFE beneficiary students is significantly lower than that of the nonbeneficiary students in FFE schools. Further, the average score of nonbeneficiary students in non-FFE union schools is slightly lower than that of the nonbeneficiary students in FFE schools (see Table 5 and Figure 1). The achievement test results from a much smaller subsample of students from the household survey also show a similar pattern (Figure 6).

Figure 6 plots household income and household-level test scores, which shows a clear and positive association between income and learning for the above three groups of FFE beneficiary and nonbeneficiary households. This result indicates that one of the main reasons why FFE beneficiary students performed worse on achievement tests than their fellow nonbeneficiary students in the same FFE schools is because they come from poorer families. Children from poor families are less likely to have educated parents (see Figure 5 above) who could help them in their studies at home, to afford study materials at home (books, stationery, etc.), and to find enough time to do the homework, as many of them must contribute to their family livelihood. Furthermore, from birth, children from poor families are often deprived of the basic nutritional building blocks that they need in order to learn easily. Therefore, FFE beneficiary students, who mostly come from poor families, are less likely to have adequate cognitive ability to learn, possibly due to their lower nutritional status at preschool age.

Figure 7 shows a positive relationship (though not strong) between income and nutritional status of preschool age children (aged 6 to 60 months) for households living in FFE and non-FFE unions. The nutritional status of preschoolers is expressed in Z-score values for weight-for-age (a measure of underweight), which is a combination of the

effects of weight-for-height (wasting) and height-for-age (stunting).[9] The differences of the average Z-scores between expenditure quartile groups are not statistically significant.

Figure 7 Nutritional status of preschool children aged 6 to 60 months, by expenditure quartile



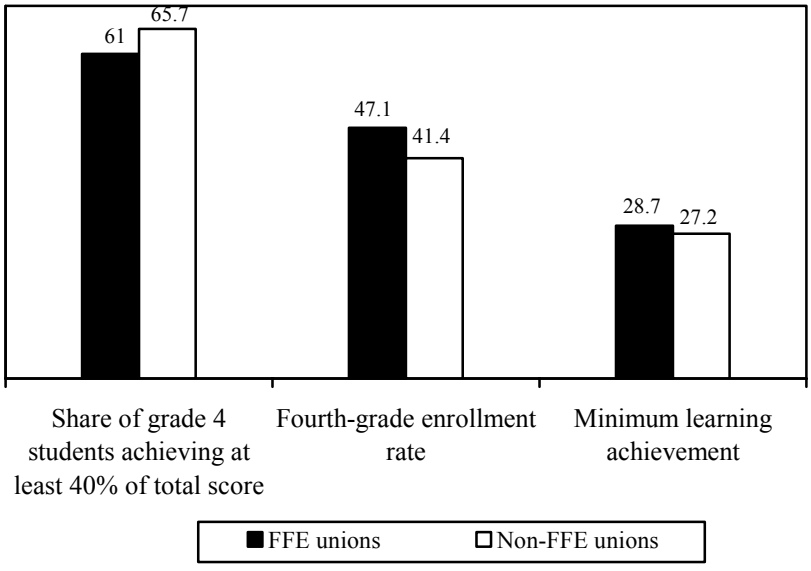
We now turn to an analysis that combines educational quality with quantity for the FFE and non-FFE communities. Following Michaelowa (2001), we constructed an indicator that captures quality and enrollment simultaneously to represent the total educational attainment in a society. We first set a threshold of minimum learning at 40 percent of correct answers in the achievement test for fourth graders. The rationale for our choice of this cutoff point has been explained above. The indicator—minimum learning achievement—is then calculated by multiplying the share of all fourth grade students at and above the threshold of minimum learning by the fourth grade enrollment

[9] Z-score = (actual measurement – 50th percentile standard)/standard deviation of 50th percentile standard. The growth standards devised by the U.S. National Center for Health Statistics (NCHS) are used in this study. A Z-score value of zero indicates a child who is "normal," and a Z-score value less than –2 indicates a child who suffers from a nutritional problem.

rate. We calculated this indicator separately for FFE unions and non-FFE unions. To calculate the minimum learning threshold, we used achievement test scores from the school survey. The data used to calculate the ratio of students in fourth grade to the number of all fourth-grade-aged children (aged 9-10 years) in a community—the gross enrollment rate for fourth grade—came from the household survey.

Figure 8 shows the minimum learning achievement in FFE and non-FFE communities. The share of all fourth-grade students achieving at least 40 percent of total test score is 61.0 percent in the FFE community and 65.7 percent in the non-FFE community. As mentioned earlier, relatively low scores of FFE beneficiary students bring down the aggregate score in FFE unions. On the other hand, the fourth-grade gross enrollment rate in FFE unions (47.1 percent) is higher than that in non-FFE unions (41.4 percent), because the FFE program entices more children to schools in FFE unions. The net result is that the minimum learning achievement in the FFE community (28.7 percent) is actually slightly higher than that in the non-FFE community (27.2 percent).

Figure 8 Minimum learning achievement in FFE and non-FFE communities



Multivariate Analysis

The descriptive statistics presented above do not permit the separation of program effects from the effects of other factors. Therefore, we used an appropriately formulated multivariate analysis to isolate the effects of other factors to capture the true effects of the FFE program on learning.

Description of the Model

To determine the impact of the FFE program on the quality of education, researchers must take into account the characteristics of the students who decided to enroll in school because of the FFE program. As the above descriptive analysis suggests, these students are likely to be of lower ability than students who enrolled in school regardless of the FFE program. Therefore, a naïve comparison between schools with the FFE program and schools without the FFE program would show that students in FFE schools had lower average test scores than schools without the FFE program. The relevant research question is whether children who would have been in school without the FFE program are now performing worse on tests because lower ability children are enrolled or because classrooms are crowded. These peer effects would be an indirect negative impact of the FFE program on children's performance in school.[10]

To investigate the possible negative impacts of the FFE program on learning, our analysis focuses on the achievement scores of the students who are not beneficiaries of the FFE program. The idea is to capture the spillover effects or negative externalities of the FFE program on the students who are not eligible to receive FFE rations.

In the sample, two types of primary-school students are nonbeneficiaries of the FFE program. The first group consists of children whose families are not eligible for benefits, although they live in unions with the FFE program and send their children to an FFE school. The second group consists of primary school students who live in unions

[10] Another relevant research question is whether the students who enroll in school because of the FFE program are learning "enough" to justify the costs of schooling to the government and the opportunity cost of the children's time. The data are not detailed enough to answer this question.

that did not have the program in 2000, so that even if the children were poor, they did not have access to the program.[11]

In our model, student achievement (*T*), the test score taken from the school survey, is determined by a set of explanatory variables. We estimate the following equation:

$$\begin{aligned} T = {} & \alpha + \beta \text{ gender of student} + \chi \text{ FFE school} \\ & + \delta \text{ percentage of fourth-grade students receiving FFE} \\ & + \phi \text{ classroom crowding} + \gamma \text{ teachers' characteristics} \\ & + \eta \text{ school processes} + \iota \text{ physical characteristics of schools} \\ & + \mu \text{ union control variables} + \varepsilon, \end{aligned} \tag{1}$$

where α is a scalar, β, χ, δ, ϕ, γ, η, ι, and μ are parameters of corresponding explanatory variables, and ε is an error term.

The dependent variable, *T*, is the achievement test score taken from the school survey, which covered 3,369 fourth-grade students in 110 schools. Only the nonbeneficiary students are chosen for the analysis. With missing data and the selection of nonbeneficiaries, a total of 1,978 observations are used. The achievement test score is the sum of the scores in Bangla and in mathematics, the most important subjects in primary school.

The controls for whether the school has an FFE program, the percentage of children in fourth grade who participate in the FFE program, and for crowding allow for a distinction among different impacts that the FFE program might have on student achievement. *FFE school* is a dummy variable equal to one if the school is an FFE school. To continue being eligible to receive FFE benefits, schools must meet a set of minimum educational quality standards, which might have a positive impact on student

[11] The FFE program targets children from poor households, most of who would not have attended school without the program. The socioeconomic status of the nonbeneficiary students in FFE schools, therefore, can roughly be compared with that of the students in non-FFE schools. As mentioned earlier in this report, the average monthly per capita expenditure of nonbeneficiary households with children attending FFE school is not statistically significantly different from the average per capita expenditure of households with children attending non-FFE primary schools.

achievement.[12] On the other hand, schools in poorer unions are more likely to be designated FFE schools than schools in richer unions, so the FFE dummy variable could indicate a poor school, which would tend to lower achievement.

The number of students in fourth-grade classrooms measures the crowding effect. Because the schools included in the sample have only one room per grade, the number of students enrolled in the school in the fourth grade is a measure of fourth-grade students per classroom.

The inclusion of both the percentage of fourth-grade students who participate in the FFE program and the number of students in the fourth-grade classrooms in the regression allows for a distinction between peer effects and resource dilution effects on nonbeneficiary students' achievement. Resource dilution effects result when class resources, such as the teacher's time, or classroom seating, are divided among increasing numbers of students. In a class of 20, teachers can spend an average of 3 minutes per hour per student, but in a class of 40, teachers can only spend an average of 1.5 minutes per hour on each student.

As the percentage of children who receive the FFE program increases, the percentage of poor, low ability students is also likely to increase. If the achievement of nonbeneficiary students decreases as the percentage of children who receive the FFE program increases, then that is an indication of negative peer effects.

If the FFE program results in more children in the classroom, and therefore resources such as the teacher's time and attention are diluted, then the impact of the number of children in the fourth grade on nonbeneficiary student achievement should be negative. Controlling for both FFE school status and the percentage of children who receive the FFE program distinguishes between the effect of having the FFE program and the extent of the program.

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[12] The minimum quality standards are (1) at least 10 percent of Grade 5 students must qualify for the annual scholarship examination, (2) students in Grades 3, 4, and 5 should obtain at least 40 percent of total points in the previous year's annual examination, and (3) the FFE ration is suspended for any school in which a random inspection reveals less than 60 percent attendance, until the attendance record improves.

Teachers' characteristics include the percentage of teachers in the school who are female, the number of teachers in the school who have at least a bachelor's degree, the average teacher salary in the school, and the proportion of teachers in the school who have other sources of income besides teaching, which is an indicator of the teachers' dedication to teaching. Although many other teacher characteristic variables are available in the data, such as teachers' experience, the teacher variables tend to be highly correlated, especially with a variable indicating that the school is a government school. Teacher experience, teacher salary, and working in a government school are positively correlated. Regression results that included a dummy variable for government school and excluded the teachers' salary variable were no different from the regression results of equation (1).

The *school processes* variables include the number of inspections per year by government officials, whether parents attend meetings at the school, and whether students are given daily homework assignments. The *physical characteristics* variables include whether the school has electricity, the number of blackboards, and whether classrooms were classified by the survey interviewers as being in poor condition.

The regression includes a series of dummy variables that control for the union-level fixed effects. Because the government attempted to give priority to poorer unions in the FFE program, the regression controls for these union characteristics in the most comprehensive manner. If the variables were left out, the estimates of the impact of attending an FFE school would be biased because the error term would be correlated with the FFE school dummy variable. This set of union dummy variables also controls for the fact that students who are nonbeneficiaries in schools that do not have the FFE program are, on average, likely to be poorer than students who are nonbeneficiaries in schools that have the FFE program. Some poor children go to school even if they do not receive an FFE ration. One could add a variable controlling for the per capita expenditure of the nonbeneficiaries aggregated to the union level, but adding the union-level dummy variable is equivalent to controlling for this variable, as well as any other union-level characteristic, both observed and unobserved.

The statistical analysis takes into account the nature of the dependent variable and the survey sampling design so as to make correct statistical inferences. The achievement test score ranges from 0 to 19, and therefore the regression is estimated as a Tobit model using the "*svyintreg*" command in Stata. This command takes into account the fact that the dependent variable is censored at 0 and 19, instead of a continuous variable that goes from positive to negative infinity. The command also corrects the standard errors for sampling effects—in this case, that the sample was stratified to include both unions that participated in the FFE program and did not participate, and that the random sampling occurred at the union level and not at the individual level.

Endogeneity problems could arise in the econometric model specification in equation (1) if school characteristics and school achievement test scores were both caused by characteristics that were not observed by the researcher. In the Appendix, we argue that in the rural Bangladesh setting, endogeneity is not the problem that often arises in other settings.

Results and Discussion

The mean, minimum, and maximum values for the variables used in the regression analysis are presented in Table 8. The results of the Tobit model estimation are presented in Table 9. To aid interpretation, the predicted achievement scores from a series of simulations that use the estimated coefficients from Table 9 are presented in Table 10.

The FFE program has a statistically significant positive impact on the achievement test scores of the nonbeneficiary students. Students who do not receive FFE benefits but go to an FFE school have significantly higher achievement test scores than students who do not attend FFE schools, controlling for union characteristics. However, this effect is mitigated to some extent by the negative and statistically significant "peer effect" on achievement test scores of nonbeneficiary students, which arise from the percentage of students in the classroom who receive FFE benefits.

Table 8 Descriptive statistics for variables used in regression analysis, nonbeneficiary students, 2000

Variable	Mean	Minimum	Maximum
Achievement test score = sum of Bangla and mathematics scores	11.60	0	19
Male student	0.46	0	1
School has FFE program	0.58	0	1
Percentage of students who participate in FFE in Grade 4	0.25	0	0.71
Measure of crowding—total number of children in Grade 4 classroom	70.27	14	180
Percentage of female teachers	0.30	0	0.80
Number of teachers with at least a Bachelors degree	1.54	0	5
Teachers' average salary per month	4,384.85	1,300	10,577
Percentage of teachers who report other sources of income	0.20	0	1
Number of inspections in last school year	5.65	0	14
Parental participation—parents come to school meetings	0.74	0	1
Children are given daily homework	0.86	0	1
School has electricity	0.34	0	1
Classrooms in poor condition as observed by survey enumerators	0.04	0	1
Number of blackboards in school	4.84	0	74
N	1978		

Table 9 Tobit regression analysis of the impact of the FFE program on the fourth-grade achievement test scores of nonbeneficiary students, 2000

Variable	Coefficient	t-test
Male student	1.109	2.35*
School has FFE program	6.812	2.40*
Percentage of students who participate in FFE in Grade 4	-9.928	-2.53*
Measure of crowding—total number of children in Grade 4 classroom	0.020	1.36
Teacher characteristics at the school level		
Percentage of female teachers	-0.954	-0.58
Number of teachers with at least a bachelor's degree	0.364	1.26
Teachers' average salary per month	0.000	0.82
Percentage of teachers who report other sources of income	-0.522	-0.39
School processes		
Number of inspections in last school year	0.060	0.57
Parental participation—parents come to school meetings	-0.386	-0.59
Children are given daily homework	0.459	0.30
Physical characteristics of schools		
School has electricity	2.310	1.81+
Classrooms in poor condition as observed by survey enumerators	-0.543	-0.55
Number of blackboards in school	0.043	2.15*
Union dummies (F test, 18, 30)	Yes	5,991.69**
N	1,978	
Sigma (goodness of fit)	5.36	33.10**

Notes: Significance levels: + significant at the 10 percent level; * significant at the 5 percent level; ** significant at the 1 percent level.

Table 10 Simulations of predicted values of learning achievement under various scenarios, coefficients from Table 9

	Predicted absolute test score	Predicted percentage of correct answers on achievement test	Percentage change from baseline
School has no FFE program	10.4	54.9	—
School has FFE program, 0 percent of students receive FFE benefits	17.2	90.7	65.2
School has FFE program, 44 percent of students receive FFE benefits (mean value)	12.9	67.7	23.3
School has FFE program, percentage of students who receive FFE benefits increases by 10 percentage points to 54 percent	11.9	62.5	-7.7
School has no electricity	11.2	58.7	—
School has electricity	13.5	70.9	20.7
School has 0 blackboards	11.7	61.7	—
School has 4.8 blackboards (mean value)	11.9	62.8	1.8
School doubles the number of blackboards to 9.6	12.1	63.9	3.6

The simulation is useful to see whether the positive effect of going to an FFE school is larger in magnitude than the negative impact of having a non-zero percentage of children receiving FFE benefits. The simulations present different scenarios. For example, the first row of Table 10 presents the predicted achievement test score that would be obtained if no schools had the FFE program. To calculate the predicted score, the variables "FFE school" and "percentage of children in fourth grade who receive FFE benefits" are set equal to 0 and then the mean score is calculated for all the nonbeneficiary students in the sample. In schools without the FFE program, on average, students would get 10.4 points on the achievement test, or 54.9 percent of the achievement test questions correct.

The scenario presented in the second row of Table 10 shows what would be the average score of nonbeneficiary students in FFE schools if there were no FFE beneficiaries in fourth-grade classrooms, hence, no peer effect. The value of the variable "FFE school" is set to 1 and the "percentage of children in fourth grade who receive FFE benefits" is kept at 0. Achievement test scores would increase by 65 percent to 90.7

percent correct answers compared to the no FFE program baseline (row 1).[13] Comparing row 2 to row 1 gives us the gross effect of being in an FFE school.

In the third row of Table 10, the value of "FFE school" is set to 1 and "the percentage of children who receive FFE benefits" is set to 44, which is the average percentage of children in fourth grade who receive FFE benefits in schools that have the FFE program. A comparison of the first and third rows shows that the net impact of the FFE program is to increase school achievement test scores of nonbeneficiaries from 10.4 points to 12.9 points (from 54.9 percent to 67.7 percent correct answers), or by 23 percent.

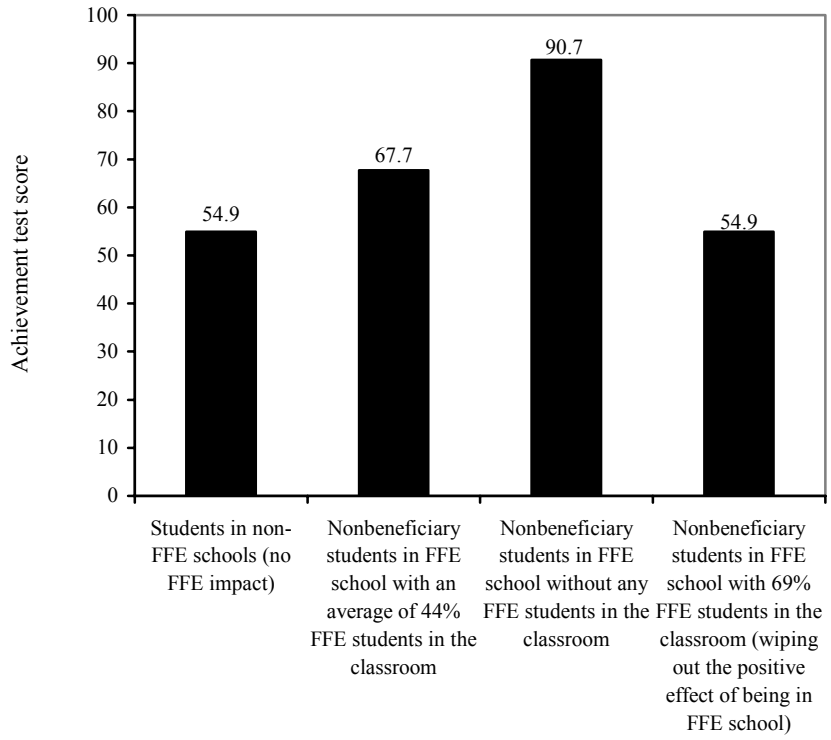
When the percentage of FFE beneficiary students in a fourth grade FFE classroom reaches 68.6 percent, then the negative peer effect arising from a high percentage of FFE children in the classroom exceeds the positive impact of being in an FFE school for the nonbeneficiary students. Figure 9 illustrates the predicted impacts of the FEE program on student achievement under different scenarios presented above.

The simulations also show what happens when the percentage of children who receive the FFE programs increases in an FFE school. Comparing rows 3 and 4 of Table 10, when the percentage of students receiving the FFE program increases by ten percentage points from 44 percent to 54 percent, the predicted test score falls from 12.9 points to 11.9 points (67.7 percent correct answers to 62.5 percent correct answers), or a decrease of 7.7 percent.

The class size or crowding effect is not statistically significant. As the number of children in fourth-grade classrooms increases, there is no statistically significant impact on achievement test scores. This finding is consistent with other findings in the literature, which have also found little impact of class size on student achievement (Glewwe 2002; Hanushek 2003; Michaelowa 2001). In the rural Bangladesh context, the finding is not

[13] The result should be interpreted with caution, because this simulation is an out-of-sample prediction—only 2 percent of nonbeneficiary fourth grade students in FFE schools have no students participating in the FFE program in their grade.

Figure 9 Predicted impacts of the FFE program on student achievement under different scenarios



likely due to disruptive students being placed in smaller classrooms, because most rural primary schools do not have the resources to provide more than one class at a grade level. These schools are not accountable to parent associations and parents have little say in school decisions. Therefore, class size is a more random variable in the rural Bangladesh context than it is in other countries; thereby, results are less likely to be biased. The finding suggests that the negative impacts of the FFE program on student achievement operate primarily through peer effects, and not through class size.

Of the remaining variables, only whether the school has electricity and the number of blackboards in the school have statistically significant impacts on nonbeneficiary student achievement test scores. The effect of increasing the number of blackboards is modest. Table 10 shows that increasing the number of blackboards from 0

to the mean of 4.8 would only increase test scores from 61.7 percent correct to 62.8 percent correct, or by 2 percent. Doubling the average number of blackboards from 4.8 to 9.6 would increase the students' scores from 11.92 to 12.14, or by about 2 percent, or an increase of 3.6 percent compared to the baseline of no blackboards. Other studies by Glewwe and Jacoby (1994) in Ghana and Michaelowa (2001) in five Sub-Saharan African countries have also found positive and significant, but small in magnitude, impacts of blackboards on student achievement. The impact of electricity is sizable. Adding electricity to all schools would increase nonbeneficiary achievement test scores by 21 percent, from 58.7 percent correct to 70.9 percent correct. Currently, only 34 percent of nonbeneficiary children attend schools with electricity. The result should be interpreted with caution, however, because having electricity could be correlated with other unobserved characteristics of the school, such as the neighborhood where it is located. Providing electricity to schools might also be very expensive compared to other interventions.

6. Conclusions

The evidence is clear from past studies that the Food for Education program in Bangladesh has been very successful at getting poor students enrolled in school, especially girls. However, as Bangladesh has not invested in school resources at the same rate that enrollment has increased, class sizes have increased. Parents, teachers, and policymakers have expressed concern about decreasing quality of FFE schools, specifically about the perceived negative impact of crowding in classrooms on student achievement.

In this paper, we made an effort to identify the determinants of educational quality, and investigated the possible negative impacts of the FFE program on learning. We used data collected from school and household surveys. These data sets include detailed information about school- and household-level characteristics, and scores from a standard achievement test administered to students.

In summary, the results of our analysis at the school-level reveal that the average test scores are lower in FFE schools than in non-FFE schools. About 40 percent of students in FFE schools are program beneficiaries and the rest are nonbeneficiaries. Within FFE schools, the average score of FFE beneficiaries is less than that of the nonbeneficiaries, which brings down the aggregate score in FFE schools. FFE beneficiaries score lower than nonbeneficiaries probably because of their relatively lower socioeconomic and nutritional status.

Gender influences student achievement. Boys consistently outperformed girls in the achievement test, regardless of FFE beneficiary status. Therefore, interventions specifically focused to promote girls' performance need to be considered. Improved quality of girls' education, in turn, would strengthen and expedite the beneficial effects of women's education on various family-level outcomes, such as children's schooling, child health and nutrition, and fertility.

One of the main sources of children's capacity and motivation to learn is the quality of family environment. Evidence from the household survey shows that children from poor households do worse on achievement tests than children from rich households. Children whose parents are educated do better on achievement tests than children whose parents are uneducated. Children from poor households are also shown to have higher incidence of malnutrition than children from rich households, which affects learning.

To investigate the possible negative impact of the FFE program on test scores, we analyze student achievement test data collected in schools in a multivariate framework. We focus on the impact of the FFE program on nonbeneficiary students' achievement. Our approach allows us to distinguish among the effects of students enrolled in an FFE school, having a higher percentage of FFE beneficiary children in the classroom, and increasing class size.

The results of our multivariate analysis reveal that the class size has no statistically significant effect on student achievement. Our finding that class size does not seem to matter to student achievement in rural Bangladesh is consistence with many studies in the economics of education literature. This finding, therefore, negates the

assertion that the increased number of students in FFE school classrooms—basically resulting from the success of the FFE program—reduced learning.

The analysis, however, shows that as the percentage of students who receive the FFE program grows, test scores of nonbeneficiary students in FFE schools decrease, implying that there are negative peer effects of the FFE program on nonbeneficiary students. For example, FFE beneficiary students are poorer and are likely to be of lower cognitive ability than nonbeneficiary students; therefore, teachers may have to pay more attention to them than the nonbeneficiary students. There may be other factors as well. We conclude that, although we do find a negative impact of the FFE program on achievement of nonbeneficiary students in FFE schools, this negative impact on learning operates primarily through peer effects, and not through class size.

The FFE beneficiary students are poorer and likely to be of lower ability than nonbeneficiary students. High ability and low ability students can be assigned to different classes, but this would require more classroom space and teachers. In rural Bangladesh, parents are probably not able to evaluate education quality very well, due to their own low-level or no education. As their education and experience increases, what may eventually happen is that wealthier families would take their children out of government-supported general primary schools and into well-funded private schools, and so the government-supported and private school market will sort children by ability.

On the other hand, our analysis suggests that the FFE program has a significant positive impact on the achievement test scores of the nonbeneficiary students. Students who do not receive FFE benefits but go to an FFE school have significantly higher test scores than students who do not attend FFE schools. This effect probably comes from the requirement that FFE schools must meet certain minimum educational quality standards in order to maintain their school-level eligibility for the program. Our simulation results suggest that, at the average percentage of FFE beneficiary students in school, the positive impact of being in a FFE school outweighs the negative impact of having a non-zero percentage of FFE beneficiary students in the classroom.

Setting clear standards for performance is important for all levels of education. In Bangladesh, although performance indicators are embodied in certification examinations at the secondary and higher levels, they are neglected at the primary level. We suggest that carefully devised, minimum performance standards be incorporated in the design of the recently implemented Primary Education Stipend program, a cash-for-education program that has replaced the FFE program, as well as in the ongoing pilot testing of the school-feeding program.[14]

Our study provides evidence that FFE beneficiary students bring down the aggregate achievement test score in FFE unions. We have also found that the gross enrollment rate in FFE unions is higher than that in nonprogram unions, because the FFE program entices more children to school in FFE unions. We constructed an index of community-level minimum learning achievement, calculated by multiplying the share of students in a community above the threshold of minimum learning by the enrollment rate in that community. We show that the FFE program has increased the minimum learning achievement in the FFE communities, thereby the FFE community as a whole benefited by achieving a higher level of quality education compared to non-FFE communities. Particularly, major benefits accrued to the children from poor families who would not have attended school without the FFE program.

All in all we conclude that, as a food-based social safety net, the FFE program in Bangladesh served a wider purpose than simply providing the poor with immediate sustenance through food transfers, important as that is. It has empowered children from poor families with education, thereby paving their pathway out of poverty.

[14] In July 2002, in order to alleviate short-term hunger in the classroom and to promote primary school enrollment and retention rate, the World Food Programme and the Government of Bangladesh launched the school-feeding program in chronically food-insecure areas of Bangladesh. The program distributes micronutrient-fortified biscuits to all children in the intervention schools.

Appendix: Potential Sources of Endogeneity

Endogeneity problems could arise in the econometric model employed in this study if school characteristics and school achievement test scores were both caused by characteristics that were not observed by the researcher. For example, if parents who place a high value on their children's schooling spend more time doing homework with their children and also choose where to live based on school resources, then the impact of school resources on children's achievement test scores is overestimated. Glewwe (2002) discusses at length the difficulties of estimating the impact of school resources, especially class size, on student achievement.

We argue that in the rural Bangladesh setting, endogeneity is not the problem that often arises in other settings. In the Bangladesh FFE program case, one might imagine that the following endogeneity problems would arise: the government allocates the FFE program and school resources to low-performing areas, leading to an underestimate of the impact of school resources on student achievement; parents choose which schools their children attend, so that motivated parents choose schools with more resources; and parents who care about schooling are able to get more government resources to their children's schools. We explain, in turn, why each of these situations does not create an endogeneity problem for our study.

The FFE program is targeted to poor rural areas. The district administration gets funds, which are allocated to the *thana*-level officials, the lowest level of government administration in Bangladesh. At the *thana* level, unions are chosen to participate based on their socioeconomic levels and their literacy rates. In the econometric model specification in equation (1), we control for this selection by including union dummy variables, which control for all observed and unobserved characteristics of the union, including those that are used to select the unions for the program. So, the targeting of the FFE program to poor areas is controlled for in the regression, as is any other targeting of school resources that occurs at the union level.

All selection of schools into the FFE program occurs at the union level. When a union is chosen for the FFE program, basically all the schools within the union are eligible, provided that they meet the regulations. All the government and registered nongovernment schools participate. Only one *madrasa* within the union is eligible, but only about 4 percent of students in our census attend a *madrasa*. The Bangladesh Rural advancement Committee (BRAC) is a nongovernmental organization (NGO) that provides schools in villages at the early primary level. BRAC opted not to participate in the FFE program, but NGOs only enroll about 6 percent of primary-school students.

The next potential source of endogeneity arises from parental choice of their children's schools. In the rural areas, where the data were collected, often only one school is available in the village. The census data collected for this study show that about 80 percent of children go to a school within their village, and the remaining 20 percent go to a school within their union. Seventy-two percent of students attend government schools, and about 13 percent go to nongovernment schools. Students in rural Bangladesh do not have much choice in the schools that they attend. In the sample of school test scores, 64 percent of the children lived in a village where there was only one school, and an additional 20 percent lived in a village where there were two schools. Therefore, in this setting, the school choice does not create as large of an endogeneity problem as it would in other settings, such as an urban area of Bangladesh.

The final source of potential endogeneity arises from parents being able to organize and obtain the political power to improve schools. Even if only one school is available in a village, parents who care about their children's education might be able to pressure the government to invest more resources in the local school or to build another school when the current school gets crowded. This scenario is unlikely in rural Bangladesh. Parents have little experience with school, and so are unable to judge school quality. Table 7 in this report shows that in FFE unions, on average, fathers have 2.3 years of schooling and mothers have 1.2 years of schooling. The people who live in the villages are mostly poor and have little political clout. Schooling resource decisions are

made at higher levels of government, not at local levels, and the administrators of these programs often have little incentive to respond to village needs.

To conclude, endogeneity of school resources and class size is not as much of a problem in our study setting as it would be in other settings. The FFE program created variation across schools in class size, and this variation allows us to estimate the impacts of being in an FFE school, having a high proportion of students who receive the FFE program, and classroom crowding on school achievement.

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