The Effect of Parental Involvement on Student Achievement in Junior Secondary School: Examining Data from the Botswana TIMSS 2007

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I. Introduction

This study examines the effect of school-based management (SBM) on student achievement, with a particular focus on junior secondary schools in Botswana. It analyzes how parental involvement affects mathematics and science test scores, using TIMSS (Trends in International Mathematics and Science Survey) 2007 data.

1. Motivation and Background of the Research

Recently many developing countries including African countries have promoted decentralization and applied school-based management (SBM) to improve the quality of basic education. SBM is "the decentralization of levels of authority to the school level" (Barrera-Osorio, Fasih, Patrinos, 2009). Under the SBM system, more decision-making and management responsibilities over school operation are given to principals, teachers, parents, sometimes students, and other community members. However, schools still have to operate within the policies determined by the central government (Barrera-Osorio et al., 2009). Given the fact that traditional approaches, which increased physical and human resources, did not sufficiently improve the quality of basic education, SBM was designed to provide an accountability system between the beneficiaries (students and parents) and the agents (teachers and policy makers) in order to improve the quality of basic education.

There is no universally used method of applying SBM and therefore each SBM have unique features. There are two key axes regarding SBM: the amount of autonomy a given school has and who manages the authority. Bruns, Filmer and

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Patrinos (2011, p. 95) categorized SBM into three levels of autonomy: strong, intermediate and weak. Strong SBM is defined as "almost full control of schools by councils, parents, and school administrators (including full choice through creation of new public schools) or high degree of autonomy given to councils over staffing and budgets". Under the intermediate SBM, "(school) Councils have authority to set curricula but limited autonomy regarding resources". With the weak SBM, "School councils (are) established but serve mainly in an advisory role".

The second component in SBM is divided into four key dimensions (Barrera-Osorio et al., 2009). The first one is administrative-control SBM in which the authority is devolved to the school principal. The second one is professional-control SBM in which teachers hold the main decision-making authority so as to use their knowledge of the school and its students. The third one is community-control SBM in which parents or the community have the major decision-making authority. The forth one is balanced-control SBM in which decision making authority is shared by parents and teachers.

Rigorous studies have been conducted to assess the effect of SBM over many countries. Most studies found measurable effects of SBM on student performance but some found small or no effects. Also there are few studies on SBM in African countries on this topic even though this system is prevalent throughout Africa.

Two African countries, Botswana and Ghana, participated in TIMSS 2007 which contains information on parental involvement in school management and school activities. The research in this paper explores the Botswana TIMSS 2007 data and analyzes the effect of parental involvement on math and science test scores in junior secondary school. The next section briefly summarizes the school-based management in Botswana.

2. School-based Management in Botswana

Botswana is a middle income country who has been active in empowering parental and community within its schools. In fact, the 1994 Revised National Policy on Education encourages the involvement of all stakeholders in basic education (Ministry of Education, Botswana, 2000; UNESCO-IBE, 2010). In primary schools, local communities are asked to participate in Parent-Teacher Associations, while community junior secondary schools have a Board of Governors (school committee) working with

school management teams and operate the school together (UNESCO-IBE, 2006; UNESCO-IBE, 2010; Isaacs, 1997). In fact, in the 1994 Revised Policy on Education, all secondary schools were asked to have Boards of Governors appointed by communities and approved by the Minister of Education (Ministry of Education, Botswana, 2001). According to Ministry of Education, Botswana (2001), Boards of Governors are responsible for "the appointment of the ancillary staff as well as for the maintenance of teachers' houses" (p. 14). Boards can also raise funds to provide additional infrastructure. In addition, schools can receive donations from private enterprises and organizations who are in partnership with the Botswanan government. The SBM in Botswana could be categorized as a strong/intermediate SBM according to the criteria set by Bruns et al. (2011). Also it is a balanced-control SBM according to the criteria set by Barrera-Osorio et al. (2009). However, in reality, the degree of parental and community involvement in school management varies by school. Usually there is no general consensus on how to involve in the SBM among schools, parents and communities (Boaduo, Milondzo, & Adjei, 2009).

3. Objective of the Study, Research Question and the Significance of the Study

Using the TIMSS 2007 data, containing some information on parental involvement in junior secondary schools, this study provides evidence of parental involvement among junior secondary schools in Botswana and its effect on student achievement. Since TIMSS 2007 does not have information on community involvement in school but parental involvement in school, this study focuses on parental involvement and its effect on student achievement at junior secondary school. Parents are an important component of SBM as they are beneficiaries of education as well as students. The key research question of the paper is "To what extent does parental involvement affect math and science test scores in junior secondary school in Botswana?".

Few studies have been conducted on SBM practices in African countries; in fact worldwide, Africa is under represented. According to Bruns et al. (2011), there is only one study on Kenya regarding the effect of SBM on student achievement in basic education (Duflo, Dupas, & Kremer, 2007), while there are five studies on five Asian countries and fifteen studies on thirteen Latin American countries. This study is relevant as there has not been a rigorous analysis on the impact of SBM and parental

involvement on student achievement in basic education in Botswana.

4. Structure of the Paper

This article consists of seven parts. The first part explains the motivation and background of the study, the application of SBM in Botswana, the research question at hand, and the related significance of the study. The second part examines previous empirical studies on the impact of SBM on student achievement. The third part explains the data and variables used in the research. The fourth section presents the methodologies utilized to estimate the effect of parental involvement in school management and activities on student achievement. The descriptive statistics and results are explained in the fifth and the sixth parts. Conclusions are discussed in the seventh.

II. Literature Review

SBM is now prevalent throughout the world and has been reported as being effective in most studies. For instance, Jimenez and Sawada (1999) evaluated community-managed schools in El Salvador using the Heckman-type correction model and found increased reading scores and decreased absenteeism. The Heckman-style correction model was also employed by Di Gropello and Marshal (2005) to assess Honduran schools and found slightly increased test scores and a slight decrease in dropout rates. Duflo, Dupas, and Kremer (2007) conducted a randomized evaluation of a project containing SBM components, which showed that SBM increased student test scores, lowered teacher absenteeism and slightly decreased dropout rates. Other studies also showed a positive impact of SBM on student performance (e.g. Gertler et al., 2010. See more studies introduced in Bruns, et al., 2011). Khattri et al. (2006) evaluated a program in the Philippines by difference-in-difference and propensity score matching and also found small positive effects of SBM on student test scores.

In contrast, some studies have found no positive effects of SBM. Gunnarsson, Orazem, Sánchez, and Verdisco (2004) analyzed ten Latin American countries employing the instrumental variable approach and found no influence of SBM on student test scores. King, Orazem, and Gunnarsson (2003) examined a program in Nicaragua using matching and panel data and found no positive impact of de jure

autonomy, while real autonomy (hire/fire teachers) increased test scores (see more examples in Bruns et al., 2011).

The results of investigations in SBM are inconclusive. Most of studies found positive effects of SBM on student performance but a few found very small or no impact of SBM. In fact, the study by King et al. (2003) suggests that the degree of autonomy among schools and actual application of SBM methods improve student achievement not legal system of SBM. As we see, there have not been many rigorous empirical studies in many countries yet, especially in African countries. It is usually very difficult to evaluate SBM because of the great variety of SBM projects and programs, and the lack of data. Only some randomized projects were conducted to examine the effect of SBM on student achievement so far. Most studies previously conducted have relied on observational data. Most of the studies conducted quasi-experimental studies using either Heckman correction, instrumental variable approach, difference-in-difference, panel data, propensity score matching, or other matching method.

III. Data

1. Trends in International Mathematics and Science Study (TIMSS) 2007

Trends in International Mathematics and Science Study (TIMSS) is an international achievement test survey conducted by International Association for the Evaluation of Educational Achievement (IEA). It measures mathematics and science achievement at the fourth and eighth grades. TIMSS has been conducted every 4 years since 1995. For the study in 2007, 59 countries participated in the study including Botswana (IEA TIMSS & PIRLS International Study Center, 2013). This study attempts to provide some evidence in Botswana using the TIMSS 2007 data, which contains information on parental involvement in junior secondary schools.

Botswana joined TIMSS in 2003 and has continued its participation. The country measured student achievement for 8th grade students, however, started to include the study of 4th grade students in 2011[1]. The Botswana TIMSS 2007 data contains 3,601 students in 127 schools with parental involvement in school committees and 523 students in 20 schools without parental involvement in school committees.

2. Dependent Variables and Independent Variables

The analysis uses math and science test scores for 8th grade students as dependent variables. The study especially uses "standardized raw scores" instead of plausible values used for international comparison because it is more appropriate when we compare test scores of students within a country (Foy & Olson, 2009).

The study employs several independent variables on parental involvement. The independent variables of interest are (1) parental involvement in the school committee at the school level (whether parents are asked to serve on the school committee or not), (2) degree of parental support for student achievement at the school level (how much parents support student achievement within school), and (3) degree of parental involvement in school activities at the school level (how much parents involve in school activities)[2]. The variable (1) is a dummy variable in which 1 means that parents are asked to serve on the school committee and 0 otherwise. Variable (2) and (3) have a 5-point scale (very low=1, low=2, medium=3, high=4, and very high=5).

Other independent variables are student, household, school, teacher and community characteristics. Student and family characteristics contains gender of student (female=1, male=0), language of test spoken at home (always=3, almost always=2, sometimes=1, never=0), dummy variables of mother and father's tertiary education attainment.

Variables across math and science teacher characteristics are gender, years of experience, teaching licensure, whether the teacher took a subject-specific major at a post-secondary level, whether the teacher majored in teaching the subject at a post-secondary level, completion of a 1st degree of theoretically based tertiary education, and completion of a 2nd degree of theoretically based tertiary education. Also pupil teacher ratio is included[3].

School characteristics contain total enrollment of school, whether a student's school has more than 50% of students from economically affluent homes, and whether a student's school has more than 50% of students from economically disadvantaged homes.

TIMSS 2007 has only one relevant community characteristics variable which is a categorical variable of the size of the city where the school is located. The estimation

uses the city size dummies (3000 people or fewer, 3001 to 15000 people, 150001 to 50000 people, 50001 to 100000 people, 100001 to 500000 people, more than 500000 people).

IV. Methodologies

1. Baseline Model

The baseline model to estimate the effect of parental involvement on student achievement is

(4.1) $Y_i = \alpha + \beta PI_i + X_i' \delta + u_i$

where Y_i is math or science test scores, PI_i is either (1) parental involvement in the school committee at the school level, (2) parental support for student achievement at the school level, or (3) parental involvement in school activities at the school level. X_i is the set of control variables including student and family characteristics (gender, language, mother's education, father's education), teacher characteristics (age, gender, teaching experience, education qualifications, pupil-teacher ratio), school characteristics (total school enrollment, if the school has more than 50% of students from economically affluent homes, if the school has more than 50% of students from economically disadvantaged homes), and community characteristics (the size of city where the school is located). The model is estimated by ordinary least squares (OLS) and propensity score matching.

2. Propensity Score Matching

In addition to the OLS, propensity score matching (PSM) is used to estimate the effect of parental involvement on student achievement. PSM is used to deal with the endogeneity of parental involvement. Parental involvement is an endogenous variable because it could be affected by unobserved characteristics of student, parents, schools and communities while these unobserved characteristics could affect student achievement. For example, a school with a motivated and skilled principal probably encourages more parental involvement in school while the principal with better school management skill could improve student test scores as well. In this case we do not know which one, parental involvement itself or the principal's school management, that improves students test scores. Therefore we need to control for this endogeneity (see

Wooldridge, 2010 for more details on endogeneity).

The propensity score is the conditional probability of assignment to a particular treatment given observed covariates (Rosenbaum & Rubin, 1983). PSM constructs a statistical comparison group based on the propensity score using observed characteristics. Individuals in the treatment group are matched to individuals who are not in the treatment group according to the propensity score. The average treatment effect of the program is estimated by calculating the mean difference in outcomes across two groups.

Rosenbaum and Rubin (1983) showed that, under certain assumptions, matching on the propensity scores $P(X) = \Pr(T = 1 \mid X)$ is as good as matching on observed characteristics X. It is easier to match on $P(X)$ than X because $P(X)$ is one variable, while X is a set of variables. The assumptions required to identify the program effect are (a) conditional independence and (b) the presence of a common support (World Bank, 2010). If external validity holds, we can estimate the average treatment effect (ATE) using PSM. However, researchers can usually ensure only internal validity so that they can estimate the average treatment effect of the treated (ATT) instead of ATE.

Conditional independence or unconfoundedness, according to Rosenbaum and Rubin (1983), means that given a vector of observable covariates X that are not affected by treatment, potential outcomes Y are independent of treatment assignment D. If $Y(1)$ equals outcomes for participants and $Y(0)$ outcomes for nonparticipants, conditional independence implies

(4.1) $Y(1), Y(0) \amalg D \mid X$ ($\amalg$ denotes independence).

This suggests that participation in the program is based entirely on observed characteristics. Rosenbaum and Rubin (1983) show that if potential outcomes are independent of treatment conditional on covariates X, they are also independent of treatment conditional on the propensity score $P(D = 1 \mid X) = P(X)$, i.e., the probability of an individual participating in a treatment given his/her observed covariates X. Hence, if Eq. (4.1) holds, all biases due to observable characteristics can be removed by conditioning on the propensity score (Imbens, 2004). Therefore

(4.2) $Y(0), Y(1) \amalg D \mid P(X)$.

To estimate the ATT instead of the ATE, weaker assumptions are required

(4.3) $Y(0) \amalg D \mid X$ and

(4.4) $Y(0) \amalg D \mid P(X)$

In this study, average treatment effect on the treated is as follows.

(4.5) $\tau_{ATT} = E(\tau \mid D = 1) = E\ [Y(1) \mid D = 1] - E[Y(0) \mid D = 1]$

where τ_{ATT} is defined as the test score differential between schools with the parental involvement in the school committee (Board of Governors) and schools without parental involvement in the school committee. $D = 1$ represents a school with parental involvement in the school committee, $D = 0$ represents schools without parental involvement in the school committee, and Y is either math or science test scores. Given the conditional independence that assumption holds and assuming additionally that there is overlap between both groups, the PSM estimator for ATT can be written in general as

(4.6) $\tau_{ATT}^{PSM} = E_{P(X) \mid D=1} \{E[Y(1) \mid D = 1, P(X)] - E[Y(0) \mid D = 0, P(X)]$

The PSM estimator is simply the mean difference in outcomes over the common support, appropriately weighted by the propensity score distribution of the participants.

The advantage of PSM is that it does not necessarily require a baseline or panel survey (World Bank, 2010). PSM is based on very strong assumptions and possibly leads to biased estimates (Heckman, Ichimura, and Todd, 1998; Shadish, Cook, & Campbell, 2002). However, the study utilizes this method since neither proper instruments nor other methods are applicable given the limited data. It is still worth conducting the PSM in addition to the OLS to examine the effects of parental involvement on student achievement.

V. Descriptive Statistics

Table 5.1 shows the descriptive statistics of the variables used in the analysis. Since the study uses the standardized raw test scores, the mean and standard deviation of math and science test scores are 50 and 10. 87% of schools of students in the dataset ask parents to serve on the school committee, or 127 of schools in the survey ask parents to serve on the school committee. The average degree of parental support for student achievement is 2.39 out of 5, while the average degree of parental involvement in school activities is 2.33 out of 5.

Female students account for 48% of all students. The measure for language of test spoken at home is 1.51, which means many students do not speak languages of test very often at home. 18% of mothers of students completed tertiary education, and 28% of fathers completed tertiary education.

Gender parity of math and science teachers in junior secondary schools is almost equal. 42% of math teachers, and 40% of science teachers in the data collected are female. Years of teaching experience of math and science teachers are 7.77 and 7.44 respectively. Almost all math and science teachers have a teaching license, while a fewer number of teachers majored in the subject (math or science) or education of the subject (math education or science education). 74% of math teachers majored in math and 61% of them majored in math education in post-secondary education. Also 69% of science teachers majored in science and 69% of them majored in science education in post-secondary education. Furthermore, 11% of math teachers completed a 1st degree of theoretically based tertiary education, and 2% of them completed a 2nd degree of theoretically based tertiary education or higher. In contrast, 74% of science teachers completed a 1st degree of theoretically based tertiary education, and 39% of them completed a 2nd degree of theoretically based tertiary education or higher. Pupil-teacher ratios are 37.4 for math and 37.0 for science respectively.

Average total enrollment of schools of students is 565.4. 17 % of students go to school where more than 50% of students are from economically affluent homes, while 49% of students go to school where more than 50% of students are from economically disadvantaged homes. Also, 5% of students go to school in a city with 3,000 people or fewer; 6% of students go to school in a city with 3001 to 15,000 people; 13% of students go to school in a city with 150,001 to 50,000 people; 18% of students go to school in a city with 50,001 to 100,000 people; 33% of students go to school in a city with 100,001 to 500,000 people; and 25% of students go to school in a city with more than 500,000 people.

Figure 5.1 and Figure 5.2 show the distributions of students in schools with and without parental involvement in the school committee on mathematics and science test scores. The distributions overlap but the ones for students whose schools are with parental involvement in the school committee are skewed to the left:

Figure 5.3 and Figure 5.4 display parental involvement in the school committee

versus math and science test scores. These figures do not show the positive correlation between parental involvement and test scores but slightly negative correlation. In contrast, a positive correlation is shown for parental support for student achievement versus student test scores, and parental involvement in school activities versus student test scores (Figure 5.5, 5.6, 5.7, 5.8).

Table 5.1 Descriptive Statistics

	Mean	SD
Outcomes		
Math score	50	10
Sciene score	50	10
Parental involvement measures		
Parental involvement in school committees (yes=1, no=0)	0.87	0.33
Parental support for student achievement (very low=1, low=2, medium=3, high=4, very high=5)	2.39	1.03
Parental involvement in school activities (very low=1, low=2, medium=3, high=4, very high=5)	2.33	0.90
Student and family characteristics		
Gender (female=1, male=0)	0.48	0.50
Language of test spoken at home (always=3, almost always=2, sometimes=1, never=0)	1.51	0.88
Mother has completed tertiary education	0.18	0.39
Father has completed tertiary education	0.28	0.45
Math teacher characteristics		
Math teacher gender (female=1, male=0)	0.42	0.49
Math teacher years of experience	7.77	5.08
Math teacher teachng licence	0.99	0.08
Math teacher majored in math in post-secondary education	0.74	0.44
Math teacher majored in education-math in post-secondary education	0.61	0.49
Math teacher completed the 1st degree of theoretically based tertiary education	0.11	0.31
Math teacher completed the 2nd degree of theoretically based tertiary education or higher	0.02	0.14
Pupil-math teacher ratio	37.43	5.19
Science teacher characteristics		
Science teacher gender (female=1, male=0)	0.40	0.49
Science teacher years of expericne	7.44	6.13
Science teacher licence	0.96	0.50
Science teacher majored in science in post-secondary education	0.69	0.46
Science teacher majored in science education in post-secondary education	0.69	0.46
Science teacher completed the 1st degree of theoretically based tertiary education	0.74	0.74
Science teacher completed the 2nd degree of theoretically based tertiary education or higher	0.39	0.77
Pupil-science teacher ratio	37.06	5.41
School Characteristics		
Total enrollment	565.49	176.10
More than 50% of students are from economically affluent homes	0.17	0.38
More thatn 50% of students are from economically disadvantaged homes	0.49	0.50
Communiyty characteristics : cize of city		
3000 people or fewer	0.05	0.22
3001 to 15000 people	0.06	0.24
15001 to 50000 people	0.13	0.34
50001 to 100000 people	0.18	0.38
100001 to 500000 people	0.33	0.47
More than 500000 people	0.25	0.47

Note: SD means standard deviation.

Figure 5.1 Distributions of Students in Schools with and without Parental Involvement in the School Committee on Average Mathematics Test Scores

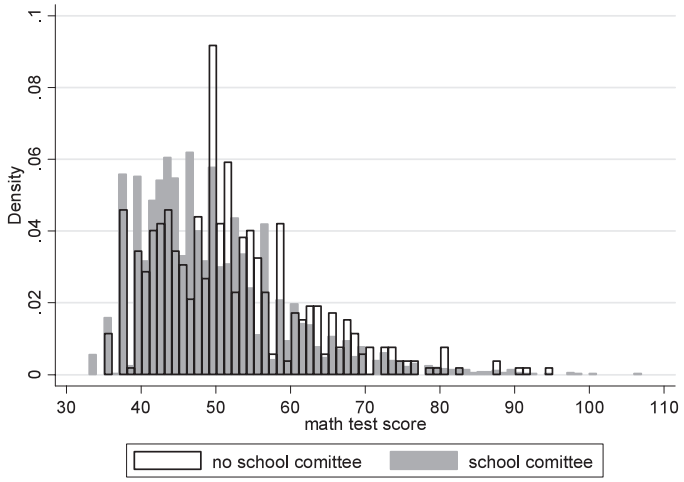


Figure 5.2 Distributions of Schools with and without Parental Involvement in the School Committee on Average Science Test Scores

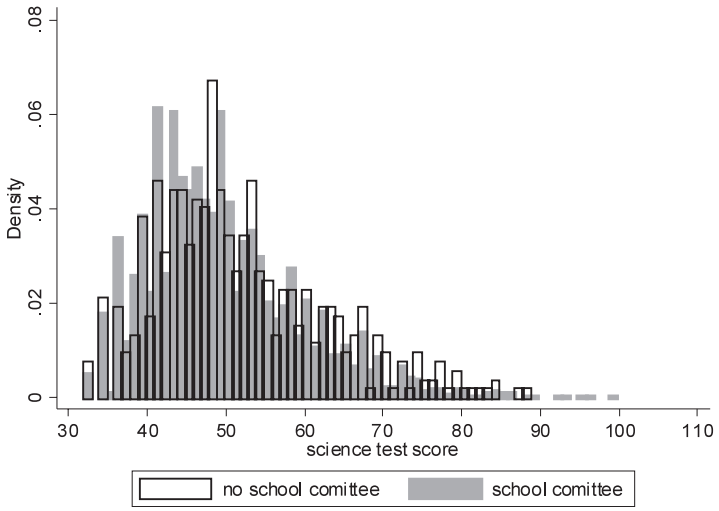


Figure 5.3 Math Test Scores Vs. Parental Involvement in the School Committee

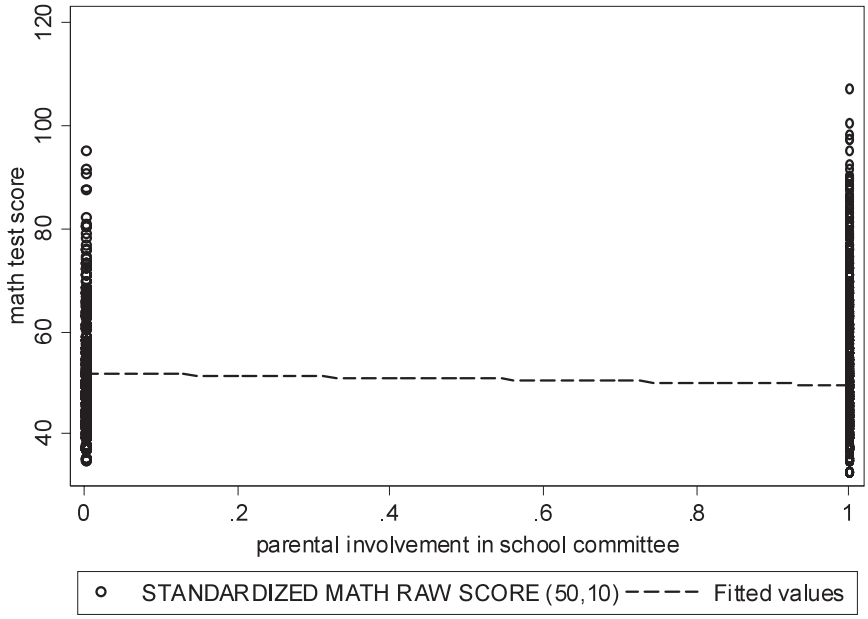


Figure 5.4 Science Test Scores Vs. Parental Involvement in the School Committee

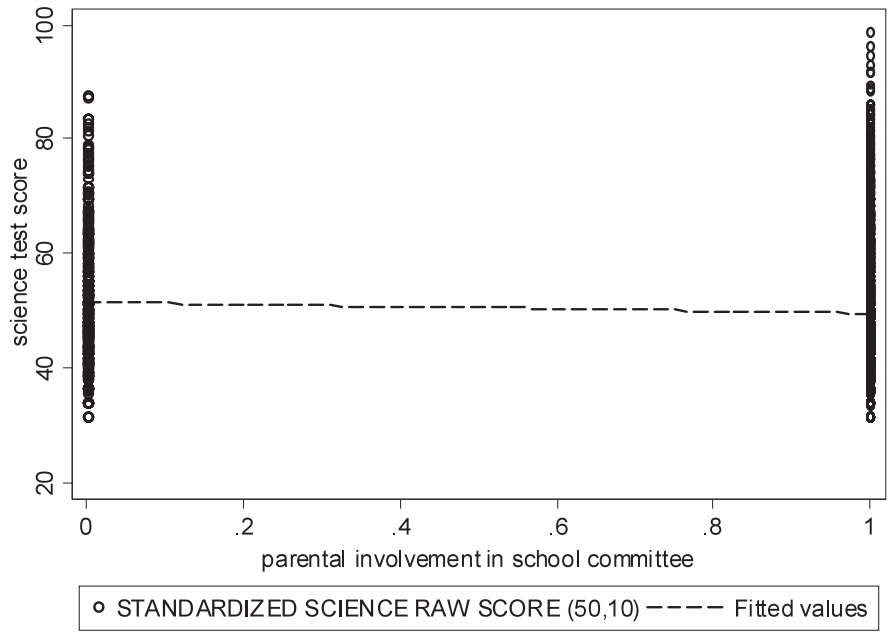


Figure 5.5 Math Test Scores Vs. Parental Support for Student Achievement

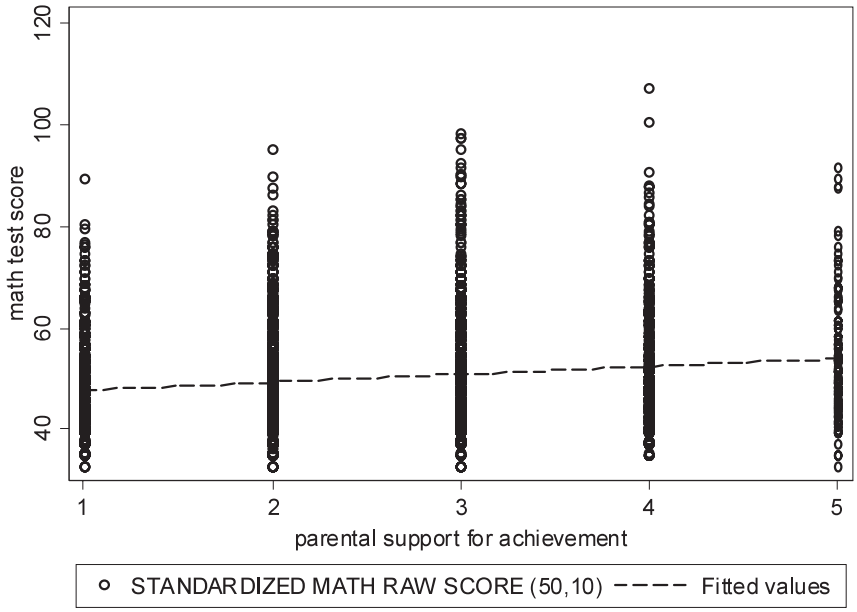


Figure 5.6 Science Test Scores Vs. Parental Support for Student Achievement

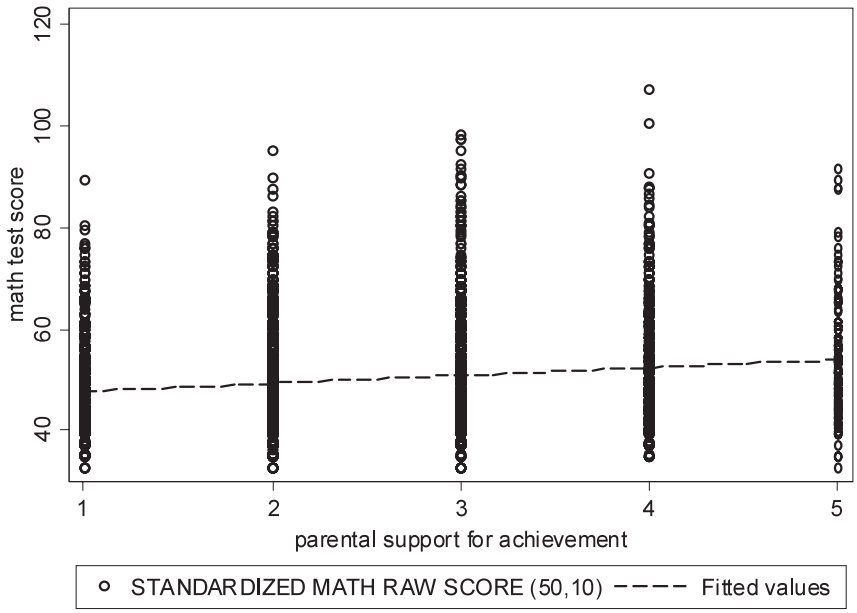


Figure 5.7 Math Test Scores Vs. Parental Involvement in School Activities

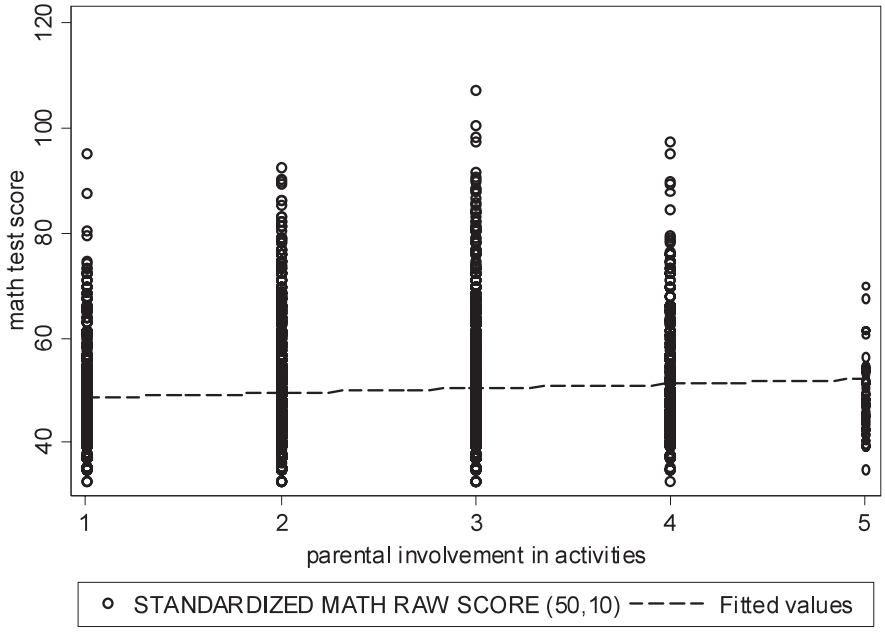
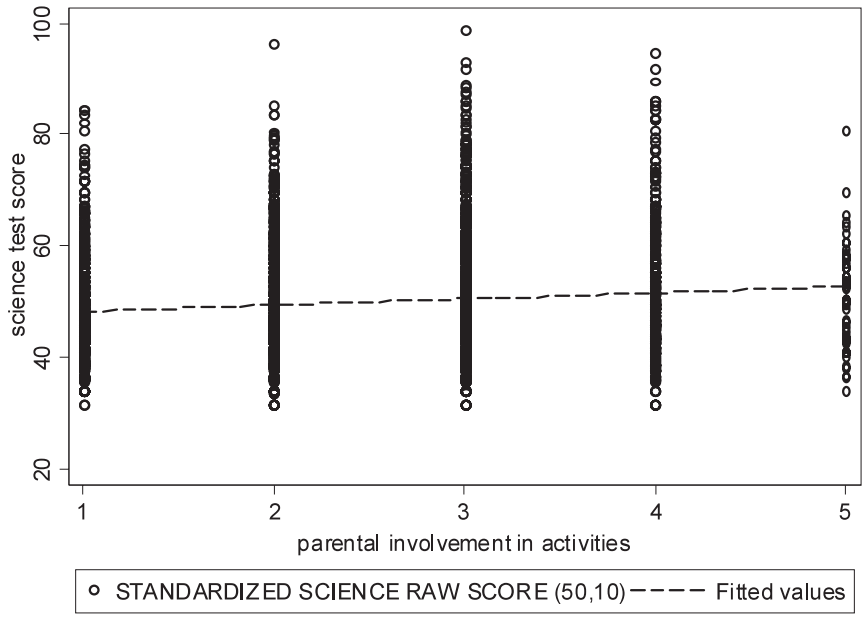


Figure 5.8 Science Test Scores Vs. Parental Involvement in School Activities



VI. Regression Results

1. Ordinary Least Square Results

Table 6.1 shows the OLS results on the effect of parental involvement in the school committee on math and science test scores. Models in columns (1) and (4) only include student and family characteristics as covariates, while models in columns (2) and (5) contain teacher and school characteristics in addition to student and family characteristics. Models in columns in (3) and (6) add city size dummies as community characteristics[4].

The estimated effect of parental involvement in the school committee on math test scores is negative and statistically significant for Models (1) and (2). Model (1) estimates that parental involvement in the school committee decreases the student standardized math test score by 1.72 points. The impact gets statistically insignificant when teacher/school characteristics and city size dummies are included in Models (2) and (3). Model (3) is considered to be the best OLS estimate since it includes variables which are likely to affect student test scores. In contrast, the estimated effect of parental involvement in school committee on science test scores is negative and statistically insignificant in all models.

Table 6.2 displays the OLS results on the effect of parental support for student achievement on math and science test scores. Again, Models (1) and (4) only include student and family characteristics as covariates, while Models (2) and (5) contains teacher and school characteristics in addition to student and family characteristics. Models (3) and (6) also have city size dummies as community characteristics.

The effect of parental support for student achievement on math test scores is positive and statistically significant for Model (1); one point increase in parental support for student achievement increases the student standardized test scores by 1.10 points for math. The effect gets statistically insignificant in models with teacher and school characteristics, and with teacher/school characteristics and city size dummies. Also, Model (4) suggests that a one point increase in parental support for student achievement increases science test score by 1.03 points. The effects are positive but statistically insignificant in Models (5) and (6) with teacher, school, and community characteristics as well.

Table 6.3 outlays the OLS results on the effect of parental involvement in school

activities on math and science test scores. Again, Model (1) shows that the effect of parental involvement in school activities is positive and statistically significant; one point increase in parental involvement in school activities is associated with 0.54 points increase in student math test scores. However, in Models (2) and (3), the impact gets statistically insignificant. In Model (4) a one point increase in parental support of student achievement estimated an increase science test scores by 0.72 points. The effects become statistically insignificant in Models (5) and (6) when teacher, school, and community characteristics are added.

In sum, the OLS results show that parental involvement in school committee, parental support for student achievement and parental involvement in school activities have no significant effect on student math and science test scores.

Another important finding is that both mother's and father's tertiary education have significantly positive impacts on math and science test scores across all models, although they are not the variables of interest in this research. For example, in Models (3) and (6) in the OLS results on the effect of parental involvement in school committees (Table 6.1), if the mother has completed a tertiary education, student test scores increase by 1.67 points and 2.35 points for math and science respectively, while student math and science test scores increase by 1.41 points and 1.47 points respectively if the father has completed a tertiary education. The OLS results on the effect of parental support for student achievement and the effect of parental involvement in school activities also show a similar effect of mother and father's tertiary education attainment (Tables 6.2 and 6.3).

2. Propensity Score Matching Results

In order to tackle the endogeneity problem of parental involvement in the school committee, propensity score matching (PSM) is used. Because the PSM compares the average treatment effect on the treated, we can only look at the effect of parental involvement in school committees as a dummy variable. The effect of parental support for student achievement and parental involvement in school activities are not estimated by PSM because these variables are discrete variables with more than two categories.

Table 6.4 show the effect of parental involvement in the school committee on math

and science test scores estimated by PSM. The PSM estimations indicate that there is no statistically significant impact of parental involvement in school committee on math and science test scores. Parental involvement in school committee is associated with a 2.29 point decrease in student math test scores but it is statistically insignificant. Also parental involvement in school committee is associated with a 2.57 point decrease in student science test scores and again this is statistically insignificant.

Table 6.1 The Effect of Parental Involvement in School Committees on Math and Science Test Scores

	Math			Science		
	(1)	(2)	(3)	(4)	(5)	(6)
Parental involvement in school committee	−1.72**	−1.43	−0.78	−1.25	−0.78	−0.74
	(0.65)	(0.82)	(0.85)	(0.65)	(0.76)	(0.81)
Student and family characteristics						
Gender (female=1, male=0)	−0.92*	−0.98*	−0.93*	−1.01*	−0.96*	−0.88
	(0.41)	(0.45)	(0.45)	(0.41)	(0.47)	(0.47)
Language of test spoken at home	0.76**	0.25	0.21	0.60*	0.36	0.35
	(0.23)	(0.25)	(0.26)	(0.23)	(0.26)	(0.27)
Mother has completed tertiary education	3.90***	2.11**	1.67*	4.32***	2.60***	2.35***
	(0.59)	(0.66)	(0.67)	(0.59)	(0.69)	(0.69)
Father has completed tertiary education	2.19***	1.53**	1.41*	1.76***	1.39*	1.47*
	(0.52)	(0.58)	(0.58)	(0.52)	(0.59)	(0.60)
Math or science teacher characteristics						
Teacher gender		1.37**	1.20*		0.59	0.72
		(0.47)	(0.48)		(0.49)	(0.51)
Teacher years of experience		0.028	−0.01		0.11*	0.083
		(0.06)	(0.06)		(0.05)	(0.05)
Teacher teachng licence		−14.4***	−13.5***		(1.09)	(1.18)
		(2.98)	(2.97)		(1.59)	(1.61)
Teacher majord in math/science in post secondary education		0.17	0.19		0.091	−0.018
		(0.54)	(0.56)		(0.58)	(0.59)
Teacher majored in math educaiton or science educaiton in post-secondary education		0.21	0.64		0.56	0.6
		(0.49)	(0.50)		(0.60)	(0.62)
Teacher completed the 1st degree of theoretically based tertiary education		3.50***	4.57***		−0.62	−0.59
		(0.92)	(0.98)		(0.43)	(0.45)
Teacher completed the 2nd degree of theoretically based tertiary education or higher		7.39***	7.19**		1.38**	1.09*
		(2.21)	(2.23)		(0.45)	(0.47)
Pupil teacher ratio in math or science class		−0.17***	−0.03		−0.19***	−0.14*
		(0.05)	(0.05)		(0.05)	(0.06)
School characteristics						
Total enrollment		0.0022	−0.0012		−0.00062	−0.0022
		(0.002)	(0.002)		(0.002)	(0.002)
More than 50% of students are from economically affluent homes		2.73***	1.38		3.77***	3.46***
		(0.74)	(0.77)		(0.76)	(0.79)
More than 50% of students are from economically disadvantaged homes		−1.19*	−1.29*		−0.69	−0.71
		(0.52)	(0.54)		(0.56)	(0.56)
Community characteristics						
City size dummies			Yes			Yes
Constant	49.0***	67.9***	63.0***	48.8***	55.6***	54.9***
	(0.75)	(3.28)	(3.41)	(0.75)	(2.66)	(2.72)
R squared	0.064	0.17	0.2	0.061	0.14	0.15
Number of observations	2057	1526	1464	2057	1484	1460

Notes: * p<0.05, ** p<0.01, *** p<0.001. Robust standard errors are in parentheses.

Table 6.2 The Effect of Parental Support for Achievement on Math and Science Test Scores

	Math			Science		
	(1)	(2)	(3)	(4)	(5)	(6)
Parental support for student achievemnet	1.10***	0.33	0.35	1.03***	0.45	0.43
	(0.21)	(0.24)	(0.25)	(0.21)	(0.26)	(0.27)
Student and family characteristics						
Gender (female=1, male=0)	−0.97*	−0.94*	−0.94*	−1.03*	−0.94*	−0.87
	(0.41)	(0.45)	(0.46)	(0.41)	(0.47)	(0.48)
Language of test spoken at home	0.70**	0.26	0.2	0.54*	0.37	0.37
	(0.23)	(0.25)	(0.26)	(0.23)	(0.27)	(0.27)
Mother has completed tertiary education	3.80***	2.25***	1.66*	4.11***	2.65***	2.41***
	(0.59)	(0.66)	(0.68)	(0.59)	(0.69)	(0.70)
Father has completed tertiary education	2.07***	1.51**	1.43*	1.70**	1.39*	1.46*
	(0.52)	(0.58)	(0.59)	(0.52)	(0.60)	(0.61)
Math or science teacher characteristics						
Teacher gender		1.44**	1.29**		0.7	0.82
		(0.48)	(0.49)		(0.49)	(0.51)
Teacher years of experience		0.041	−0.015		0.099*	0.074
		(0.05)	(0.06)		−1.48	(0.05)
Math teacher teachng licence		−14.5***	−13.3***		1.15*	0.86
		(2.96)	(2.95)		(0.46)	(0.49)
Teacher majord in math/science in post secondary education		0.14	0.2		0.13	−0.028
		(0.54)	(0.56)		(0.57)	(0.59)
Teacher majored in math educaiton or science educaiton in post-secondary education		0.21	0.6		0.65	0.66
		(0.49)	(0.50)		(0.60)	(0.62)
Math teacher completed the 1st degree of theoretically based tertiary education		3.74***	5.09***		−1.48	−1.57
		(0.91)	(1.05)		(1.60)	(1.62)
Math teacher completed the 2nd degree of theoretically based tertiary education or higher		6.53**	6.73**		−0.54	−052
		(2.20)	(2.24)		(0.44)	(0.46)
Pupil teacher ratio in math or science class		−0.19***	−0.047		−0.20***	−0.16**
		(0.05)	(0.05)		(0.05)	(0.06)
School characteristics						
Total enrollment		0.0023	−0.0011		−0.00097	−0.0025
		(0.002)	(0.002)		(0.002)	(0.002)
More than 50% of students are from economically affluent homes		2.53***	1.01		3.53***	3.22***
		(0.75)	(0.79)		(0.78)	(0.81)
More thatn 50% of students are from economically disadvantaged homes		−1	−1.19*		−0.59	−0.62
		(0.53)	(0.54)		(0.56)	(0.57)
Community characteristics						
City size dummies			Yes			Yes
Constant	45.0***	66.3***	61.9***	45.4***	54.8***	54.2***
	(0.65)	(3.25)	(3.38)	(0.65)	(2.63)	(2.69)
R squared	0.076	0.17	0.21	0.072	0.14	0.15
Number of observations	2041	1510	1427	2041	1463	1439

Notes: * p<0.05, ** p<0.01, *** p<0.001. Robust standard errors are in parentheses.

Table 6.3 The Effect of Parental Involvement in School Activities for on Math and Science Test Scores

	Math			Science		
	(1)	(2)	(3)	(4)	(5)	(6)
Parental involvement in school activities	0.54*	0.012	0.19	0.72**	0.33	0.34
	(0.24)	(0.26)	(0.27)	(0.23)	(0.28)	(0.28)
Student and family characteristics						
Gender (female=1, male=0)	−0.92*	−0.93*	−0.94*	−1.03*	−1.01*	−0.95*
	(0.41)	(0.45)	(0.46)	(0.41)	(0.47)	(0.47)
Language of test spoken at home	0.73**	0.27	0.2	0.55*	0.37	0.36
	(0.23)	(0.25)	(0.26)	(0.23)	(0.26)	(0.27)
Mother has completed tertiary education	3.79***	2.06**	1.45*	4.02***	2.43***	2.18**
	(0.59)	(0.66)	(0.68)	(0.59)	(0.69)	(0.70)
Father has completed tertiary education	2.17***	1.57**	1.45*	1.72***	1.32*	1.37*
	(0.52)	(0.57)	(0.59)	(0.52)	(0.59)	(0.60)
Math or science teacher characteristics						
Teacher gender		1.37**	1.15*		0.62	0.76
		(0.47)	(0.48)		(0.49)	(0.51)
Teacher years of experience		0.054	0.024		0.13*	0.11*
		(0.06)	(0.06)		(0.05)	(0.05)
Math teacher teachng licence		−14.7***	−13.3***		1.22**	0.86
		(2.96)	(2.96)		(0.45)	(0.47)
Teacher majord in math/science in post secondary education		0.033	0.23		0.21	0.026
		(0.54)	(0.56)		(0.57)	(0.59)
Teacher majored in math educaiton or science educaiton in post-secondary education		0.33	0.77		0.56	0.46
		(0.48)	(0.50)		(0.60)	(0.63)
Math teacher completed the 1st degree of theoretically based tertiary education		3.67***	5.25***		−1.1	−1.18
		(0.91)	(1.05)		(1.59)	(1.60)
Math teacher completed the 2nd degree of theoretically based tertiary education or higher		6.84**	6.56**		−0.65	−0.73
		(2.19)	(2.23)		(0.44)	(0.47)
Pupil teacher ratio in math or science class		−0.18***	−0.044		−0.21***	−0.17**
		(0.05)	(0.05)		(0.05)	(0.06)
School characteristics						
Total enrollment		0.0023	−0.00093		−0.00039	−0.0016
		(0.002)	(0.002)		(0.002)	(0.002)
More than 50% of students are from economically affluent homes		2.91***	1.39		3.97***	3.70***
		(0.73)	(0.77)		(0.77)	(0.79)
More thatn 50% of students are from economically disadvantaged homes		−1.06*	−1.10*		−0.47	−0.44
		(0.53)	(0.54)		(0.56)	(0.57)
Community characteristics						
City size dummies			Yes			Yes
Constant	46.2***	66.9***	61.6***	46.1***	54.5***	54.1***
	(0.7)	(3.27)	(3.41)	(0.7)	(2.67)	(2.74)
R squared	0.061	0.17	0.2	0.059	0.14	0.14
Number of observations	2048	1517	1434	2048	1470	1446

Notes: * p<0.05, ** p<0.01, *** p<0.001. Robust standard errors are in parentheses.

Table 6.4 The Effect of Parental Involvement in School Committees, Estimated by Propensity Score Matching

	Math	Science
	(1)	(2)
Parental involvement in school committee	−2.287	−2.569
	(1.928)	(2.748)
Number of treated	1433	1522
Number of untreated	179	186

Note: Standard errors are in parentheses.

VII. Conclusions

Botswana has been encouraging parents (and communities) to become more involved in school management and activities in junior secondary schools since Revised National Policy on Education was released in 1994. However, no rigorous studies exist that can assess the impact of the school-based management and parental involvement on student performance. This study utilized TIMSS 2007 data to explore the impact of parental involvement in school management and activities on student math and science test scores in junior secondary schools.

This study could not find a systematic relationship between parental involvement and test scores in both OLS and PSM models. As already suggested, the degree of parental involvement and contents of activities they have conducted affect the quality of education. If we had more information, we could explore the reasons for the no effect of parental involvement but unfortunately, TIMSS did not collect sufficient data on the details of SBM and parental involvement.

Furthermore, the issue of endogeneity has not been completely resolved yet because we possibly have unobserved characteristics not included in the PSM model. Also, the smaller number of students and schools without parental involvement on school committees could be a reason for the statistically insignificant results in PSM and OLS results on the effect of parental involvement in school committees.

Further study is needed to examine concrete data and employ other methodologies such as instrumental variable approach and Heckman two-step correction model.

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Notes

1 The data from TIMSS 2011 was just released and this study was unable to include the data. Further study will conduct research on Botswana using TIMSS 2011.

2 The exact question wordings asked to schools are as follows. Parental involvement in school committees: "Does your school ask parents to serve on school committee (e.g., select school personnel, review school finances)?" Parental support for student achievement: "How would you characterize parental support for student achievement?" Parental involvement in school activities: "How would you characterize parental involvement in school activities?"

3 Pupil-teacher ratios for math and science are not exactly the characteristics of teachers but they are included in this category, teacher characteristics, as a matter of convenience.

4 A model in a specific column is called Model (column number) from the next paragraph.