

The Correlation of Expenditure on School Level and Students' Academic Performance: Based on the Empirical Study in Western Poor Rural China

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Abstract. As a means to alleviate poverty, the Chinese government has been investing in education by increasing financial resources for schools. However, scholarship on the relationship between school resources and student academic performance has not reached a consensus. This study examines the relationship between school-level expenditures, a key aspect of school resources, and student academic performance. Using data collected in 94 rural primary school in designated poverty areas of western rural China, the empirical study found that school expenditures on students and teachers account for only 12% of total expenditures, while expenditures on school administration is as high as 72%. Expenditures on students and teachers (software) are positively correlated with student academic performance. However, expenditures on school administration (hardware) were negatively correlated with academic performance. These findings have strong implications for the structure of school spending and rural education.

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Research Background and Problem

SINCE the 18th National Congress of the Communist Party of China (CPC), the Party Central Committee, with General Secretary Jinping Xi as the core, made a series of profound expositions and comprehensive deployment of poverty alleviation and development work, and clearly defined poverty-alleviation via education as an important way to block the transmission of poverty from generation to generation. With the implementation of a series of policies on poverty-alleviation via education, enormous achievements have been made in education investment paired with an increasing growth of the investment in government finance, school and society (China Education Daily, 2017). As the key training target for education poverty alleviation and compulsory education, the educational resources and investment obtained in rural poverty-stricken areas was an achievement of breakthrough growth. According to the statistics, during the period of the 12th Five-Year Plan, 90% of the central government educational funds for transfer payment were used in the central and western regions, part of which was mainly used in poor rural areas (Zhu, 2016).

Although the funds invested in schools in poor rural areas was continued to increase, many scholars have shown that there is an imbalance in the allocation of educational resources. When the investment is uneven, the government obviously focuses on the proportion of investment in hardware. A lot of work has been done in transforming schools with weak strengths and narrowing the gaps in school hardware facilities, but not enough attention has been paid to the construction of “software” in schools (Cheng, 2015). In the process of education poverty alleviation and development, although many schools in poverty-stricken areas have been built into “the most beautiful buildings in the rural region”, the quality of education is difficult to improve; there are still serious problems in the allocation of educational resources in poverty-stricken areas (Li and Xing, 2018).

In fact, the scholarship has paid attention to the educational investment on school level and has identified its relationship with academic performance. The earliest research can be traced back to James Coleman's Coleman Report in 1966, which reportedly has little to do with school resources and students' academic performance (Coleman et al., 1966). This conclusion has aroused widespread controversy, leading many scholars to devote themselves to study the impact of school resource allocation on students' academic performance. Three major factors of school expenditure (including school expenditure, and the scale of teachers and classes) are considered as important parts of education investment (Hanushek, 2002). Studies of the relationship between school expenditures and students' achievements has also presented an inconsistent conclusion: increasing educational facilities was not enough to improve students' academic performance demonstrated by the research results of Angrist and Lavy in 1999; but Dewey et al. (2000) found that the increase of school expenditures can do improve students' academic performance.

Why did research on the relationship between school expenditure and academic performance not reach a consistent conclusion? The reasons are as follows: First, differ-

ent scholars use different variables, and the second, statistical methods are also diverse. In addition, students' academic performance may be affected by factors such as family background, in addition to the influence of school resource allocation. If ignore these variables, the final result will be biased. At the same time, few people have conducted research and analysis on the relationship between different aspects of school expenditure and students' academic performance. The goal of this paper is to analyze the expenditure on school level and to explore the relationship between different aspects of school expenditure and students' academic performance. The rest of this paper is organized as follows. The next section of the paper describes our sample selection, data, and empirical methods. The third section presents the results. The final section discusses and concludes.

Method

Sampling

The data were collected from the project “Survey on Basic Situation of Primary Schools in Poor Rural Areas” conducted by the Center for Experimental Economics in Education of Shaanxi Normal University. The project was carried out in May, 2015, and implemented among the rural schools in the four provinces of Q, N, G and S in northwest China.

Stratified random sampling is used to select a total of 94 rural schools among 38 poverty-stricken counties of four provinces. There are 46 schools from G province, 16 from N, 14 from Q and 18 from S. A total of 6,497 students are randomly selected from 1-2 classes in the fourth and fifth grades of each school. In the survey, half of the students in each class are randomly selected to take standardized math test, and the other half take standardized Chinese test. The distribution of the sample in each province is shown in **Table 1**. The sample size was large and the coverage was wide. Therefore, the data obtained were representative.

Table 1. Distribution of Study Sample.

		# of Schools	# of Students	# of Students Taking Chinese Test	# of Students Taking Math Test
	Total	94	6,497	3,278	3,219
Province	G	46	2,366	1,204	1,162
	N	16	1,955	977	978
	Q	14	1,230	622	608
	S	18	946	475	471
Gender	Male	-	3,295	1,642	1,653
	Female	-	3,202	1,636	1,566
Grade	4th Grade	-	3,136	1,587	1,549
	5th Grade	-	3,361	1,691	1,670

Data Source: Authors' survey (2015)

Data Collection

The survey was consisted of three parts: the expenditures at school level; basic information of schools, teachers, students, and parents; students' mathematics and Chinese standardization tests. This corresponds to the independent variables, control variables and dependent variables in this study, which are described in three parts as follows.

Expenditures at School Level (Independent Variable)

In the questionnaire of schools' basic information, we interviewed the principals towards 10 expenditure items at school level, including: public utilities expenditure, office supplies expenditure, teaching supplies expenditure, teacher welfare expenditure, teacher training expenditure and canteen worker salary expenditure, non-teacher staff salary expenditure, student learning materials expenditure, student scholarship expenditure and the expenditure on school maintenance. On the basis of the expenditure items, we divided it into four aspects: "Expenditure on students", "Expenditure on teachers", "Expenditure on schools (administrative affairs)" and "Other Expenditure". Among them, "student learning material expenditure" and "student scholarship expenditure" are classified as "Expenditure on students"; "expenditure on teacher training" and "expenditure on teacher welfare" are categorized as Expenditure on teachers; "Public utilities expenditure" "office supplies expenditure" "school maintenance expenditure" and "teaching supplies expenditure" are classified as Expenditure on schools (administrative affairs); "canteen worker salary expenditure" and "non-teacher staff salary expenditure" are classified as Other expenditures (see **Table 2**). At the same time, the expenditures on students and teachers are regarded as the expenditures on "software" of schools in this paper, and the expenditures on school (administrative affairs) as the expenditures on the "hardware" of schools.

Table 2. Items and Aspects of Expenditure at School Level.

	Expenditure Aspect	Expenditure Item
Expenditures at School Level	Expenditure on students	Student learning material expenditure Student scholarship expenditure
	Expenditure on teachers	Expenditures on teacher training Expenditures on teacher welfare
	Expenditure on schools	Public utility expenditure Office supplies expenditure School maintenance expenditure Teaching supplies expenditure
	Other expenditure	Canteen worker salary expenditure Non-teacher staff salary expenditure

Data Source: Authors' survey (2015)

Data on Schools, Teachers, Students and Parents (Control Variables)

In the questionnaire, we also collected the data at the levels of schools and teachers. The school level variables mainly include: the number of students in the school, the student-teacher ratio, and the service time of the school to the farthest village; Variables at the teacher level mainly include: gender of teacher, whether the first degree is college, teaching age, and whether they are working at a public school, including Chinese teacher and math teacher. A large number of studies have shown that the variables selected above about school and teacher has impact on students' academic performance (Todd & Wolpin, 2007; Sun et al., 2009; Xue and Wang, 2009).

In the questionnaire of basic information of students and their parents, we collected variables that are at student level, including age, gender, ethnicity, grade and boarding status. At the same time, the socioeconomic characteristic variables of the parents are also collected, including: their education, whether they are migrant workers, household assets. It is found that the socioeconomic characteristics variables of individuals and families selected above have great impact on students' academic performance (Fryer & Levitt, 2004).

Standardized Math and Chinese Tests (Dependent Variables)

Data on the standardized math/Chinese scores were collected from math/Chinese tests administered as part of the survey. Each student in the sample took a standardized math or Chinese test. We selected a set of standardized Chinese and math test for students to measure their academic performance. Standardized Chinese and math tests are designed to be consistent with the syllabus and have been tested for several times so as to better gauge Chinese students' academic performance.

In this study, the scores of Chinese and math are used as dependent variables; in general, the score is well represented. Because of the different subjects tested and the difficulty of the questions between different grades, the measurement methods commonly used in previous studies, such as "parents' evaluation of children's academic performance" (Xue, 2014) and the grades reported by students themselves (Dang, 2007), may cause biased.

Standard Chinese or math scores are the result of standardizing the raw scores of Chinese or math test. This comparison is performed in two grades, making the score comparable across grades. If the standard score is higher than 0, it means that the student's Chinese or math score is higher than the average score of the student.

Sample Characteristics

The descriptive statistical results of sample are shown in **Table 3**.

Model

Table 3. Variable Description and Descriptive Statistics.

Variable level	Variable	Variable description	Mean	SD
Student and Parent Level	Age	Year	11.5	1.09
	Gender	1 = Female; 0 = Male	0.49	0.50
	Ethnicity	1 = Han; 0 = Minorities	0.66	0.47
	Grade	1 = 5th grade; 0 = 4th grade	0.51	0.50
	Boarding status	1 = Board at school; 0 = Not board at school	0.24	0.43
	Education of father	1 = Junior high school and above; 0 = Below junior high school	0.45	0.50
	Education of mother	1 = Junior high school and above; 0 = Below junior high school	0.28	0.45
	Father migrated	1 = Yes; 0 = No	0.54	0.50
	Mother migrated	1 = Yes; 0 = No	0.28	0.45
	Household assets	Standardized household assets	0.04	1.10
	Gender	1 = Male; 0 = Female	0.42	0.49
Chinese Teacher-Level	First degree is college	1 = Yes; 0 = No	0.64	0.47
	Teaching age	1 \geq 10 yrs; 0 < 10 yrs	0.50	0.50
	Work at a public school	1 = Yes; 0 = No	0.87	0.34
Mathematics Teacher-Level	Gender	1 = Male; 0 = Female	0.58	0.49
	First degree is college	1 = Yes; 0 = No	0.56	0.50
	Teaching age	1 \geq 10 yrs; 0 < 10 yrs	0.52	0.50
	Work at a public school	1 = Yes; 0 = No	0.89	0.31
School-Level	Number of students in school	Unit	401	424
	Student-teacher ratio	%	17.0	20.0
	The time from school to the farthest village	Minutes	60.3	36.8

Data Source: Authors' survey (2015)

Based on the above analysis, the econometric model to analyze the impact of different aspects of school expenditure on students' academic performance is as follows:

$$Y_{is} = \beta_0 + \beta_1 \text{Expend}_s + \gamma X_i + \eta S_s + \alpha T_s + \varepsilon_i$$

Where Y_{is} is the standardized math or Chinese score of student i at school s , Expend_s refers to the variable of expenditures in different aspects at school level, which represents the expenditures on students, teachers and school (administrative affairs) and other aspects, respectively. X_i represents the variables of student and family, including the age, gender, ethnicity, grade, boarding status, education level of parents, whether parents are migrated and family assets. T_s represents the variables at school level, including the number of students in the school, the ratio of students to teachers, and the service time from the school to the farthest village. S_s refers to the variables at the teacher level, including the gender of the Chinese or math teacher, whether the first degree is college, teaching age and whether they are working at a public school.

Holding student/household/teacher/school characteristics constant and controlling for county fixed effect, β_1 represents the effect of expenditures in different aspects on students' academic performance (indicating that if the expenditure in a certain aspect

increases from 0 to 1, the student's Chinese or math score will change by the standard deviations of β_1).

Results

The Proportion of Expenditure in Each Aspect at School Level

In the survey, the research team carefully recorded the expenditure amount of each aspect at school level. Based on the expenditure amount of each aspect and the amount of total expenditure, the proportion of each aspect and its expenditure is obtained by calculating. Among the expenditures of each aspect, the ratio of expenditure on students is the lowest, 4%; the ratio of expenditure on schools (administration) is up to 72%; the ratio of expenditure on teachers is 8%, and other expenditure is 15%. It can be seen that expenditure on students and teachers is very low, but expenditure on school hardware (school administration) is very high.

The Relationship between Expenditures of Each Aspect at School Level and Students' Chinese Academic Performance

As shown in **Table 4**, holding student/household/teacher/school characteristics constant and controlling for county fixed effect, there is a positive correlation between the expenditures on students and teachers and students' standardized Chinese scores. While the expenditures on school (administrative affairs) are negatively correlated with students' Chinese standardization scores; other expenditures have nothing to do with students' standardized Chinese scores.

Table 4. The Correlation between Expenditures in Each Aspect at School Level and Students' Chinese Academic Performance.

	Standardized Chinese Score			
	(1)	(2)	(3)	(4)
Expenditures on Students	1.34*** (0.42)			
Expenditures on Teachers		0.83** (0.34)		
Expenditures on Schools			-0.34*** (0.16)	
Other Expenditures				-0.12 (0.22)
Controlling for Child and Parent Characteristics	Yes	Yes	Yes	Yes
Controlling for Chinese Teacher Characteristics	Yes	Yes	Yes	Yes
Controlling for School Characteristics	Yes	Yes	Yes	Yes
County Fixed Effects	Yes	Yes	Yes	Yes
N	3,278	3,278	3,278	3,278
R ²	0.27	0.27	0.27	0.27

Notes: Robust standard error adjusted for clustering at the school level are reported in parentheses *Significant at 10%; **Significant at 5%; ***Significant at 1%

Data Source: Authors' survey (2015)

Specifically speaking, if the expenditure on students increases from 0 to 1, the students' Chinese scores will be increased by 1.34 standard deviations, it can also be said that if the expenditure on students increases by 1 percentage point, the students' Chinese scores will be increased by 0.0134 standard deviations, the increase of scores is statistically significant at the 1% level. If the expenditure on teachers increases from 0 to 1, students' Chinese scores will be increased by 0.83 standard deviations (if the expenditure on teachers increases 1 percentage, it will lead to an increase of 0.0083 standard deviations on students' Chinese scores), the increase in scores is statistically significant at the 5%; If the expenditure on school increases from 0 to 1, the students' Chinese scores will be decreased by 0.34 standard deviations (if the expenditures on school increases by 1 percentage point, it will cause a decrease of 0.0034 standard deviations on students' Chinese scores), the reduction of score is statistically significant at the 1% level; Other expenditure have nothing to do with students' Chinese scores.

The Relationship between Expenditures of Each Aspect at School Level and Students' Math Academic Performance

As shown in **Table 5**, holding student/household/teacher/school characteristics constant and controlling for county fixed effect, expenditures on students and on other aspects are positively correlated with student's standardized math scores; expenditures on school (administrative affairs) are negatively correlated with the student's standardized math scores; the expenditures on teachers have nothing to do with the student's standardized math scores.

Table 5. The Correlation between Expenditures in Each Aspect at School Level and Students' Math Academic Performance.

	Standardized Math Score			
	(1)	(2)	(3)	(4)
Expenditures on Students	2.00***(0.47)			
Expenditures on Teachers		0.46(0.36)		
Expenditures on Schools			-0.57***(0.17)	
Other Expenditures				0.39*(0.23)
Controlling for Child and Parent Characteristics	Yes	Yes	Yes	Yes
Controlling for Math Teacher Characteristics	Yes	Yes	Yes	Yes
Controlling for School Characteristics	Yes	Yes	Yes	Yes
County Fixed Effects	Yes	Yes	Yes	Yes
N	3,219	3,219	3,219	3,219
R ²	0.20	0.20	0.20	0.20

Notes: Robust standard error adjusted for clustering at the school level are reported in parentheses *Significant at 10%; **Significant at 5%; ***Significant at 1%

Data Source: Authors' survey (2015)

Specifically, if expenditure on students increases from 0 to 1, the student's math score will increase by 2 standard deviations. It can also be said that if expenditure on students increases by 1 percentage point, the student's math score increases by 0.02 standard deviations, the increase of scores is statistically significant at the 1% level; if the other expenditures increase from 0 to 1, the student's math score will increase by 0.39 standard deviations (if other expenditure increases 1 percentage, it will lead to an increase of 0.0039 standard deviations on students' math scores), the increase in scores is statistically significant at the 10%; If the expenditure on school increases from 0 to 1, the students' math scores will be decreased by 0.57 standard deviations (if the expenditures on school increases by 1 percentage point, it will cause a decrease of 0.0057 standard deviations on students' math scores), the reduction of score is statistically significant at the 1% level; expenditure on teachers have nothing to do with students' math scores.

The Relationship between the Expenditures on Software and Hardware and Students' Academic Performance

Taking the expenditures on students and teachers as the expenditure on "software" and the expenditure on school (administrative affairs) as the expenditure on "hardware", we make a further analysis of the relationship between the expenditures on "software" and "hardware" and students' Chinese and math academic performance. The results show that, as shown in **Table 6**. Expenditures on "software" has a significant positive impact on students' Chinese and math scores, while the expenditures on "hardware" has a huge negative impact on that. Among them, if the expenditure on "software" increases from 0 to 1, students' Chinese score will be increased by 1 standard deviation, and students' math score will be increased by 0.91 standard deviations, the increase of scores is statistically significant at the 1% level. If expenditure on "hardware" increases from 0 to 1, students' Chinese and math scores will be decreased by 0.34 standard deviations and 0.57 standard deviations respectively, the reduction of scores is statistically significant at the 1% -5% levels.

Conclusions and Suggestions

This study used representative data to explore the current state of expenditure on school level in poor rural primary schools and correlation to students' academic performance. According to results, primary schools in poor rural areas are over-emphasizing the expenditure on school administration ("hardware"), up to 72%, while expenditure on students and teachers ("software") accounted for only 12%. The results showed that in terms of expenditures on "software", both expenditures on students and teachers are significantly positively correlated with students' Chinese and mathematics performance, but the "hardware" expenditures of school administration are significantly negatively correlated with students' Chinese and mathematics performance. Based on the results, we propose corresponding countermeasures and recommendations.

Table 6. The Correlation between Expenditures on Schools' Software and Hardware and Students' Academic Performance.

	Standardized Chinese Score		Standardized Math Score	
	(1)	(2)	(1)	(2)
Expenditures on Software	1.00***(0.26)		0.91***(0.27)	
Expenditures on Hardware		-0.34**(0.16)		-0.57*** (0.17)
Controlling for Child And Parent Characteristics	Yes	Yes	Yes	Yes
Controlling for Chinese/Math Teacher Characteristics	Yes	Yes	Yes	Yes
Controlling for School Characteristics	Yes	Yes	Yes	Yes
County Fixed Effects	Yes	Yes	Yes	Yes
N	3,278	3,278	3,219	3,219
R ²	0.27	0.27	0.20	0.20

Notes: Robust standard error adjusted for clustering at the school level are reported in parentheses *Significant at 10%; **Significant at 5%; ***Significant at 1%

Data Source: Authors' survey (2015)

To Improve and Optimize the School Expenditure and Increase the Expenditures on Students and Teachers

At present, the expenditure structure at school is of “material-oriented” model, that means investment in schools’ “hardware” is higher, and investment in school’s “software” is lower. However, there is a positive correlation between the expenditure of the school “software” and students’ academic performance. In terms of this, we need to change the existing expenditure of “material-oriented” model, and increase the proportion of expenditures on students and teachers, which is to make the transformation of the investment mode of “material-oriented” to “people-oriented” so as to stimulate the creativity of students and teachers, and jointly improve the creative vitality of talents.

Targeted Measures Should Be Taken in the Process of Education Poverty Alleviation

In the process of implementing the strategy of targeted education poverty alleviation, attention should be paid to the “precision” and “accuracy” of fiscal policies. In order to achieve targeted poverty alleviation via education, on the one hand, the object should be targeted, and the resources of education poverty alleviation should be effectively allocated to the people who have urgent needs: the investment of software supporting service for students and teachers should be improved to maximize the efficiency of resource allocation. On the other hand, the measures should be taken precisely: improve the teaching ability of teachers in poor areas through a variety of ways to promote the professional development of teachers; the financial aid to students is transformed from

indemnificatory to all-round pattern, so that students and teachers in poor areas can be assisted in the aspects of ideology, abilities and growth (Liu & Liu, 2018).

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