The Effect of Total Expenditures per Student on AP Exam Pass Rates

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Abstract:

This study explores the statistical relationship between expenditure per student and AP standardized testing scores. The value of a potential positive correlation between the chosen variables could indicate that increased funding in secondary education could lead to better prepared students in terms of college readiness; which in turn could lead to more prepared, future participants of the labor force.

1. Introduction

Socioeconomic factors have arguably played a role in student achievements ever since James Coleman elucidated the issue in 1966 (Coleman, 1966). Since then, many studies have been conducted and as a result, have led to school finance reforms in order to increase school funding (Candelaria and Shores, 2017). The goal evidently is to minimize education inequality and increase educational attainment. Therefore, our question is: Does a school's total expenditure per student affect educational attainment measured by AP scores of students in Texas high schools?

We chose to research the effect of total expenditure per student on AP exam pass rates because it is important to see how much funding plays a role in a student's education and future. If we knew that increased funding improved AP exam pass rates, then this could be a valid reason for schools to receive more money. AP scores can be an indicator of college readiness. If students score high enough, they can receive college credit for the class if their college of choice accepts it. We expect there to be a positive correlation between total expenditures and AP exam pass rates because when schools have a larger budget, they are able to purchase various practice materials and updated technology for students to utilize in their preparation for their AP exams. Thus, these students will have seen similar questions that will be on the exam and they will know what to expect by the time they take the actual exam. Providing students with a better education will help to shape the future.

In the following sections, we will provide background on our chosen variables and their relationships in academic literature, an overview of our model and explain how we chose our variables based on our cross-sectional data file, present the empirical results of our analysis and their significance in terms of applicability, and conclude with our closing remark regarding our study.

2. Literature Review

Many academic articles proved to be useful while conducting our research. One in particular by Jaschik (2019), covered the differences in AP scores among races. This article provided a table titled "Mean scores by Race and Ethnicity on Selection of AP Exams, 2018." The data showed that minorities, except Asian Americans, on average scored less than white students. Flower (2008) explains that the reasoning behind such low scores among minorities is African Americans and Hispanic students are more likely to come from low-income families. Students that come from low-income families usually attend poorly funded high schools. These high schools lack proper funding for AP programs to take place. Lower-income students are limited to educational resources and opportunities whereas high-income students are not. This is significant to our theory because it presents information on how a student's low socioeconomic status affects their AP scores.

We also studied another article by Rozon (2013), and found further research on the disadvantages that low-income students face. Students from low-income families live in smaller tax base areas which consequently reflects the quality of the schools in that area. The largest

source of funding for schools generally comes from taxes therefore schools in low tax bracket areas are typically of lower quality (Rozon 2013). Higher-income students have the advantage of attending higher quality schools with better teachers and more learning resources. According to Rozon (2013), these factors all play a role in a student's test scores and explains why there is a difference in test scores among students that attend lower and higher-quality schools. Another point that Rozon (2013) covers is the significance of gender scores. He found that males scored higher on science and math while females scored higher on language and reading tests. The reason behind this was believed to be that males have superior spatial skills than females and therefore do better in math. Essentially this supports our research because it shows that students' test scores are affected by the quality of schools due to their funding and that there are also differences in scores between genders. These articles failed to show how the size of schools affect scores, but we will try to show its significance in our research if there is one.

3. Model Specification

The data that we will be using came from an excel file that was provided by Professor Schulman. This file includes 1217 different Texas highschools from many districts. We will be measuring AP Exam pass rate vs. Total Expenditures. To measure the total amount of expenditures, we will sum the amount of money, in US dollars, spent on instructional, leadership, guidance, and extra-curricular expenditures for each school. This variable will be

defined as total_exp. AP Exam pass rate will be defined as pass_rate. This represents the AP Exam pass rate for said school. This will be a number ranging from 0 to 100.

In order to accurately measure our data, we decided to introduce control variables. These variables are sex and type of community the school is located. Sex will be defined as female_share and it represents the total number of women enrolled divided by the total number of men and women enrolled for each school. The variable, female_share, will be expressed as a percentage in decimal form. We chose sex to be one of our control variables because males and females learn in different ways and women are typically more mature at this age. The type of community will be broken down into 4 dummy variables: Rural, Town, City, and Suburb. We will use City as the base variable and the rest will be included as regressors. We included the community variable in our study because different areas are wealthier or more educated than others.

We believe that the sign on total_exp will be positive because we expect total expenditures per student to increase AP exam pass rates. We expect the coefficient on the variable, rural, to be negative because rural areas tend to be less educated. Since schools in towns are usually more funded than schools in the city, we expect there to be a very small positive coefficient on towns. People in the suburbs are generally wealthier than people in the city, so we expect there to be a very small positive coefficient on suburb variable. Men and women can be of equal intelligence, so the female_share coefficient is expected to be very small. We think it will be positive because women are more mature at this age and take school more seriously than men.

Figure 1. Summary Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
pass_rate	1,072	38.10401	23.74268	.9	100
total_exp	1,210	8860.045	3568.591	0	55716
city	1,217	.3541495	.4784514	0	1
rural	1,217	.3073131	.4615699	0	1
suburb	1,217	.2103533	.4077271	0	1
town	1,217	.1281841	.3344321	0	1
female_share	1,185	.4964898	.0685523	0	1

Regression Equation:

$$pass\_rate = \beta_0 + \beta_1(total\_exp) + \beta_2(rural) + \beta_3(suburb) + \beta_4(town) + \beta_5(female\_share) + \mu$$

To construct the variables representing the type of community the school is located in, we used the command “tabulate rural_urban, generate(region)”. Then the variables were renamed accordingly. To create the female_share variable, the command “gen female_share = (femaleenrollment / totalenrollment)” was used.

Null and alternative hypotheses:

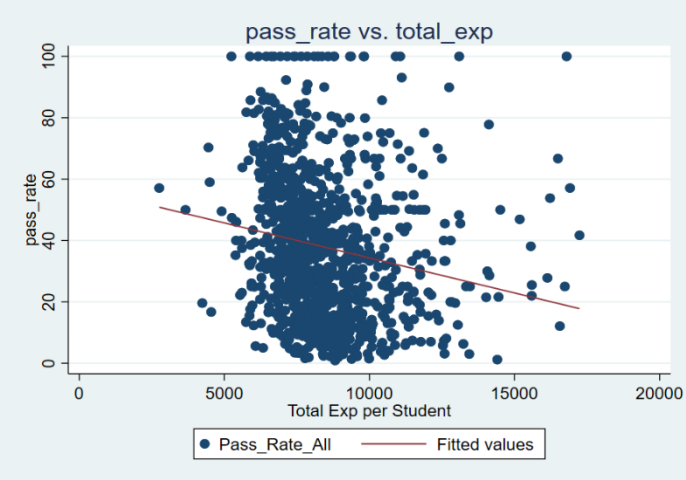
H_o: There is no difference between total expenditures per student and AP exam pass rates

H_A: Increased total expenditures results in a higher AP exam pass rate

An F-Test was chosen to be utilized due to the large number of observations in our data file.

4. Empirical Results

Figure 2. Scatter plot



The scatter plot suggests a slight negative correlation between the total expenditures per student and the AP exam pass rate. Fig. 2 shows AP exam passing rates declining as total expenditure per student increases. In other words, spending more on students' education does not translate to higher test scores. This gives reason to believe that schools with fewer expenditures per student tend to pass AP exams at a higher rate.

Figure 3. Regression results

Regression 1:

$pass\_rate = \beta_0 + \beta_1(total\_exp) + \mu$

Regression 2:

$pass\_rate = \beta_0 + \beta_1(total\_exp) + \beta_2(rural) + \beta_3(suburb) + \beta_4(town) + \mu$

Regression 3:

$pass\_rate = \beta_0 + \beta_1(total\_exp) + \beta_2(rural) + \beta_3(suburb) + \beta_4(town) + \beta_5(female\_share) + \mu$

	(1) pass_rate	(2) pass_rate	(3) pass_rate
total_exp	-0.000540*	-0.000495*	-0.000536*
	(-2.46)	(-2.28)	(-2.44)
rural		5.926***	6.628***
		(3.32)	(3.63)
suburb		8.265***	8.553***
		(4.35)	(4.44)
town		-1.444	-0.893
		(-0.62)	(-0.37)
female_share			0.192
			(1.85)
_cons	42.56***	38.84***	29.30***
	(21.00)	(17.51)	(5.21)
N	1067	1067	1045

t statistics in parentheses
* p<0.05, ** p<0.01, *** p<0.001

From the regressions in figure 3, we see that total expenditures per student is statistically significant at the .05 level for all three of the regressions. Thus, we reject the null hypothesis at the .05 level for each regression. Since the coefficient on total_exp is statistically significant and is negative, we have reasons to believe that an increase in the total expenditures per student decreases AP exam pass rate slightly.

The coefficients of rural and suburb are statistically significant at every level in each regression that they are included in. From this observation, there is evidence that students from both Rural and Suburb areas score differently from students who live in the city. Furthermore, the coefficients on rural and suburb for the second regression are 5.926 and 8.265 respectively, which suggests higher AP exam pass rates in these locations compared to the city. However, the coefficient on town is not statistically significant at any level. This gives reason to believe that AP exam pass rates for students in the town do not differ from students in the city. We expected this because towns are the most similar to cities compared to the other communities.

After looking at the variable controlling for sex, we see that this coefficient is not statistically significant at any level. This indicates that sex does not play a significant role in AP exam pass rates. Thus, we have reasons to believe that men and women tend to pass AP exams at similar percentages.

In the first regression, β_1= .00054 and β_0=42.56. This regression contains no control variables. In the second regression, β_1=.000495 and β_0=38.84. β_0 increases (becomes less negative) and β_1 decreases when we add our community variables in the second regression. The absolute value of the standard error on β_0 and β_1 both decrease. So, by adding the community

variables, β_0 and β_1 become less significant, which makes our model slightly less significant. This implies that the community variables do not make a helpful contribution with respect to our assumption. However, β_0 and β_1 are still statistically significant, so the change is very small. In the third regression, we added the control variable for sex. By doing this, the standard error on β_0 becomes more negative than it was in the second regression and the standard error on β_1 becomes less positive. The standard error on β_2 and β_3 becomes more positive. The standard error on β_4 becomes less negative. By including sex as a regressor, β_1, β_2 and β_3 become more statistically significant. Thus, sex has a small significant effect on our model in favor of our assumption.

Since we have observed that schools who spend more money per student results in a lower AP exam pass rate, we can suggest reasons why this may be the case. Technology may not always be a good thing for students. If more students have laptops in class, then they might browse the internet or play games rather than focusing on the material being taught.

A one unit increase on the independent variables does not have a large effect. If we were to increase total expenditures per student from $5,000 to $5,001, AP exam pass rates are expected to decrease by .0005%. Although this is statistically significant in statistics, this results in a very small change in a real life situation. If there was a $1000 dollar increase in total expenditures per student, AP exam pass rates are expected to decrease by .536%. Again, this is a very small change in AP exam pass rates.

When measuring what determines the pass rate of exams, there are many variables that can affect this. In our regression, we did not control for the natural talent of a student and the size of the school. It is extremely difficult to measure the natural talent of a student in high

school. This includes test-taking ability and the IQ score of a student. Some people are naturally poor test-takers, others excel in this category. The only way we could control for natural talent would be if we had the IQ scores of all of the students. We could then average the IQ scores for each school and include this in our regression. Unfortunately, we did not have this information in our data set. We believe that the natural talent of a student plays the largest role in determining their AP exam pass rate. The size of the school is another variable that could possibly affect the AP exam pass rate. Schools with a smaller student to teacher ratio may allow students to have a better learning experience in the classroom. More questions could be asked during class time and there could be a better relationship between the students and the teacher. However, we do not know for sure if this would provide a significant change in our regression.

5. Conclusion

Education essentially facilitates future economic growth, which is why we focus our research on how total expenditure per student affects AP exam pass rates. The cross-sectional data of 1217 Texas high schools shows differences in expenditures per student and AP exam passing rates. Our control variables are sex and the type of community in which the schools are located. They indicate that the passing rate between females and males is not statistically significant, but the location of schools is. Students that attend schools in rural and suburban areas score higher than those in cities and towns. We find that there is a negative correlation between total expenditures per student and AP exam pass rates and thus we reject our null

hypothesis. Our results suggest that spending more money on students will slightly decrease student AP exam pass rates. These results conclude that increasing funding for schools does not positively affect AP exam passing rates as we originally hypothesized. Therefore, further research on sizes of schools and students' natural talents should be considered when conducting research on what increases AP exam pass rates.

[Jaqueline was responsible for the literature review, introduction, conclusion, and helped with interpreting the graphs and the regression. Brendan was responsible for the introduction, model specification, empirical results, and generating and interpreting the graphs and regression.]

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