Senior Project

Department of Economics

"*Do higher property values raise school quality?*"

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Do higher property values raise school quality?

Abstract

I will use this paper to outline my analysis of school ratings and property value data to determine if the value of homes within a school district impacts the school quality or performance. Understanding the impact that the local residential property values have on the school district's performance is important for consumers, the real estate industry, and municipal agencies. This data would also be useful for the school district itself, particularly when it comes to developing and implementing an effective budget and funding plan. The legislative branch of our government would be especially interested in this information as it helps clarify how the money directed to each district will be capitalized in better performance and as an extension of student performance state economic growth

Introduction & Motivation

The objective of this analysis is to demonstrate that the income from property values directly impact the local school districts quality ratings and student performance. In the U.S., schools are funded by three sources: local, state, and federal governments. With a lot of variation from state to state, an average of 45% of the school funding is paid by local government, 45% is paid by the state, and 10% is paid by the federal government. There is a significant difference between state funding; from with 90% state school funding to Hawaii with only 28% of school funding being supplied by the state (Chingos and Blagg November 2017). State funding sources vary from state to state as well. In Ohio, for example, a portion of the school funding is from the Ohio Lottery. However, the Ohio Lottery only generates approximately $50.00 per child. This is not much considering the Ohio per pupil cost is an average of $11,276.00 per year. (Cleveland Heights-University Height City School District, https://www.chuh.org/SchoolFundingPrimer.aspx).

Ohio school funding is complicated. Districts do not just receive funding based on any program or merit. Instead, they must act on incentive programs offered by the state and request money through these programs. In addition, the state may direct funds to the districts with high-need students but will have little control over how those funds are spent within the district. From 1970 to 2010, forty-two states have had their school funding system challenged in the courts. In Ohio, the Coalition of Schools brought a case to the state and argued that relying on property taxes for school funding unfairly favored districts with higher property values. This was the DeRolph vs. the State of Ohio case and has been ruled on four times. The first ruling was in 1997 and the last in 2002. Every time, the court ruled that using property tax to fund schools was unconstitutional. The grounds for these decisions was noted as due to the variation in funding from affluent neighborhoods compared with poorer neighborhoods that the school would receive from each. The court wrote:

"A system without basic instructional materials and supplies can hardly constitute a thorough and efficient system of common schools throughout the state as mandated by our Constitution." (Education Law Center, http://www.edlawcenter.org/states/ohio.html)

In a later decision, the Court also wrote:

"A thorough system means that each and every school district has enough funds to operate, an efficient system is one in which each and every school district in the state has an ample number of teachers, sound buildings that are in compliance with state fire and building codes, and equipment sufficient for all students to be afforded an educational opportunity." (Education Law Center, http://www.edlawcenter.org/states/ohio.html)

Although the court ruled on how not to fund Ohio schools, it did not give a clear direction of how schools should be funded. The court only directed legislation to create something more equitable and in the interim, they directed more state funds to the school systems, especially those in disadvantaged areas.

Since the first DeRolph decision in 1997, schools have relied more on levies for local funding. Critics of this decision have remained active in calling for a complete overhaul of school funding in Ohio. In 1976, inflation in the U.S. was high and home values were on the rise. To prevent property taxes from increasing too much, too fast, Ohio legislature enacted House Bill 920 ("HB 920"). HB 920 governed the property taxes going to schools by freezing the dollar amount school districts could receive at the dollar amount they would have received in

1976. As inflation increased, so did the cost of school supplies, wages, and expenses the schools incurred. However, the income from property taxes remained the same. State aid to schools was increased to help offset the loss of revenues but many law makers argued it was not enough.

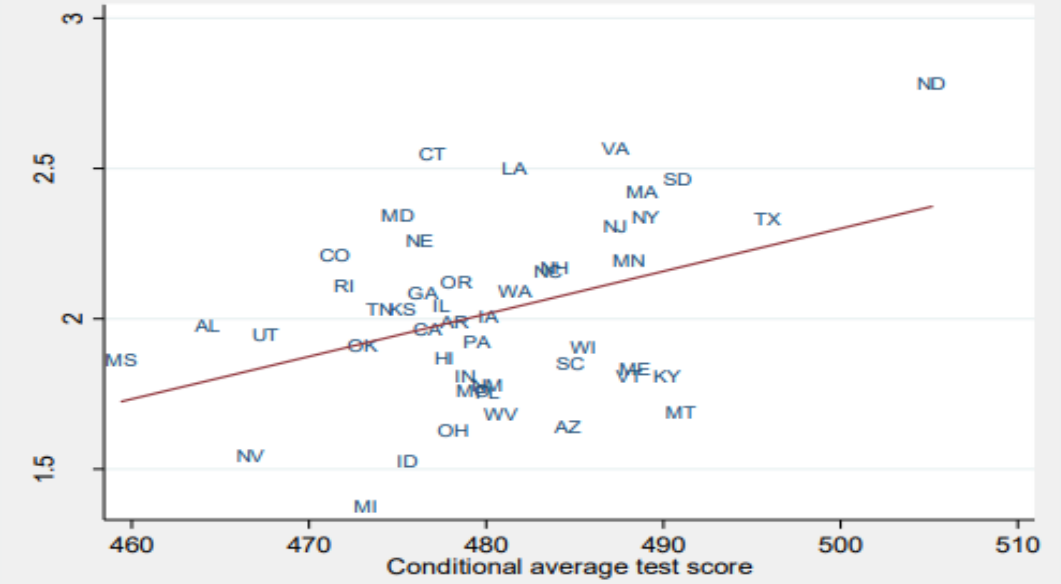
The purpose of this paper is to attempt to find a relationship with the government's assessment of school quality relative to the school district property values. The data set used for this paper has all Ohio school districts with all socio-economic data, school performance data, and districts' average property value data from data set 2017 and 2018. The models for my regression will look at the quality of each of Ohio's schools and the total value of all property in the school district. My goal is to show there is evidence that higher property valuation (more revenue for schools) can affect the school districts' quality. My regression will estimate school quality against the property values. The null hypothesis is that school quality is not affected by local property values. It has well been established that a higher quality school will attract people willing to pay a premium for living in the that school district. In my research I read several studies on the topic all show data to support the idea that a better school will raise property values within the school district. Many of these studies demonstrate that there is most likely a two-way causation; however, none sought to prove it. Table 1 below has the variables used to prove this hypothesis with the description of each variable. Also included is the mean and the standard deviation of each variable.

Literature Review

Many studies have sought to establish a link between school quality and home values. Most recently, researchers have looked at the standardized test score as a measure of school quality and have compared these scores to the housing values in the same school district or across borders. I found many research papers establishing a strong link that a high-quality school is related to increasing property values. However, there is evidence of two-way causation which was referenced in a number of different studies that I reviewed. However, I could not find any studies directly measuring school quality through home values. For this reason, I chose to establish a relationship in the opposite direction; higher property values are capitalized in better school performance.

While property values are relatively straight forward, there are many ways to measure school quality. Studies have used student standardized test scores, while some have used graduation rates. Since President Bush signed into law the No Child Left Behind Bill in 2002, which established a standardized grading system for schools, gathering school quality is easier. While there are criticisms of the testing, it does give the opportunity to gather the same information on all Ohio schools under the same testing criteria. My paper will hopefully add some clarity to the issue by showing that local government can improve communities by implementing sound policy to raise school quality. Historically, state gains from school improvements have been high. See figure 1 below showing the GDP growth compared to test scores. (Hanushek)

Figure 1. Economic Growth (1970–2010) and Cognitive Skills Across States



Note: This is an added-variable plot of a regression of the average annual rate of growth (in percentage) of real GDP per capita in 1970–2010 on the initial level of (log) real GDP per capita in 1970. The average test scores were adjusted for internal migrants by education and international migrants by selectivity, average years of schooling in 1970, and (log) real physical capital per worker in 1970 (mean of the unconditional variables added to each axis).
Source: Eric A. Hanushek, Jens Ruhose, and Ludger Woessmann, "Economic Gains from Educational Reform by US States," *Journal of Human Capital* 11, no. 4 (Winter 2017): 447–86.

This topic was first studied by Charles Tiebout (Tiebout (1946)). In his paper, "A pure theory of local expenditures", he said that people essentially vote with their feet. People will choose to migrate to areas that give them the option of consuming the goods they prefer. This includes

government provided services such as policing, maintaining community space, and public schools. These services are not free and will be reflected in the property tax values of the residents in the community. Of the many aspects that add value to a house or a community, the quality of the local schools is sometimes difficult to quantify. Tiebout's study opened the door to this topic and dozens of studies have been conducted since.

I was able to find dozens studied showing better schools raised property taxes and included one in this analysis. Figlio (Figlio and Maurice (2000)) explored and explained whether school ratings had any effect on house prices. If better schools are treated as a good, then the school district would have higher housing prices. The sample population was a school district in Gainesville, Florida. The school grading system in Florida was not started until May of 1999. The Florida School Accountability system was implemented as part of Jeb Bush's A+ education plan. Schools were ranked from "A" to "F" just like a student would be ranked on a report card. All the schools in Gainesville were between "A" and "D", there were no "F" rated schools. The timing of this implementation was advantageous for the researcher because housing data was available before and after in institution of the school grading system. This gave the researcher the ability to see the effect of implementing the grading system on housing values. There were 199 housing subdivisions or neighborhoods, each with an average of 143 homes. These homes are all in the same school district covering 20 elementary schools. Upon implementing the school grading system, Gainesville saw a spike in housing market activity in the couple months before the implementation and a few months after the implementation.

The model in this paper analyzed the price of the house and regressed it against the test scores, and several dummy variables; for example: grade, school, and level. All real-estate transactions were mapped into school zones with house prices pulled from real estate transactions within a set time period. The most recent school test score averages for each school were used in the model. The results of the model showed that the difference between an "A" rated school and a "B" rated school was represented in a $1,492.00 average increase in home value in the "A" rated school district. And a home in a "B" rated school district is worth $5,435.00 more than a home in a "C" rated school district. Although this study showed the correlation in the opposite direction from my analysis, it did admit a two-way causation most likely existed.

While I found many studies looking at the correlation of schools' quality and property values, most looked at the issue as schools affecting the property values, such as the study above. Almost all studies admitted there must be a two-way causation but did not seek to prove the assumption. Hanushek and Woesmann's study "School Resources and Student Achievement" (Hanushek and Woesmann 2011) measured how school resources affected academic achievement. More specifically, they compared school expenditure and class size against student achievement. I am going to focus on the school expenditure part, as it ties in with my study. While I am looking at property tax value, it is directly related to the school's ability to spend more on a per student basis. Hanushek and Woessman's study also looks at each country's schools, not just the United States of America's schools. They used a cross country comparative approach, including several countries' school systems. This approach was advantageous due to a larger variation that would not be available with any single country. Their model is below and resembles the education production function.

$$T = a_0 + a_1F + a_2R + a_3I + a_4A + e$$

T is the outcome of the educational production process, as measured by test scores of mathematics, science, and reading achievement. The F captures facets of student and family background characteristics, R is a measure of school resources. I is the institutional features of schools and education systems. Lastly, A is individual ability. This study included data from 29 different countries that were a part of the Organization for Economic Cooperation and Development (OECD). The study also used test results of ages 6 to 15 year old students from PISA test in 2003. The model incorporates individual student achievement in math as a function of large set of inputs factors.
The result of this study showed no correlation between school resources and student performance. But when the two extreme outliers were removed, Greece and Mexico, the model did show a weak positive association.

Nicoletti and Rabe also found a positive relationship of 6% increase of test results for every $1000 spent per student (Nicoletti and Rabe (2017)). This study used a two-step estimation process designed to eliminate some of the biases found in other studies. In other studies, biases

such as missed family characteristics and measurement errors in test scores were found. They used administration data on state schools in England and compared the data to the coefficient on school expenditure and past achievement. In the first step of the process, the test scores used in the study were from an age range of 11 to 16 and a range of subjects. This helped control for students' characteristics, who may be better in certain subjects but naturally less successful in others. In the second step, school fixed effects to control for unobserved heterogeneity between schools.

With the Derolph decision in mind, Scott R. Sweetland's studied school quality and funding in his paper, "An Assessment of the Adequacy of Ohio School Funding: New Performance Standards and Alternative Measurements of Adequacy". This is a study of what the cost of an adequate education is taking into account the new standard of school quality since the DeRolph decision. The first step of this study was to establish the definition of an "adequate education". This had been defined before for other studies but refined for this paper. The definition of an adequate education was proclaimed as "it means an education by which a student has a reasonable prospect of obtaining the academic or vocational skill needed to succeed at the next level of education endeavor or in the labor market". The performance criteria, if this was met, was established as passing of the 9^{th} and 12^{th} grade proficiency tests. Any school with a dropout rate at or above the 70^{th} percentile was omitted leaving 299 of Ohio's 611 schools at the time. By using schools with low dropout rates and removing schools in the bottom and top 5% for average expenditures made sure that outliers where not included. Sweetland's study found that the average expenditure, for a successful school district, ranged from $7,245.00 to $$15,589.00 per pupil. A successful school district had property values ranging from $70,238.00 to $225,689.00 per pupil. Sweetland found evidence that the average income of students that pertained to a successful school district ranged from $34,511.00 to $89,456.00. This study supports the claim that Ohio schools are underfunded.

Theory

The theory of my paper is that higher property values would increase a school's quality, raising the value of the student's education. I looked at the overall property value of the school district as most districts have a mix of residential, business, and industrial, with some having agricultural. A town with mostly residential communities may want more businesses in the school district as they bring more tax revenue, effectively lowering the residents' tax burden and overall funding the schools at a higher rate

Base Econometric Model

My base model for my analysis is:

$$y = B0 + B1(District\ \ value\ \ per\ \ pupil) +\ \ B2(Average\ \ income\ \ per\ \ pupil) + e$$

Y is the measure of school quality, measured by looking at the "Four year graduation rate" or the "Value added score" given to the school by the Ohio Department of Education. "Value Per pupil" is the school district's assessed property value expressed in a per pupil value. "Average Income" is the average income of all residents in the school district.

I would expect a positive relationship with both variables when it comes to school quality; as the property value per pupil goes up, so does the tax contributions to the school. This would mean if all else is the same, that the school would have more per student funds to dedicate to education. Likewise, as the per resident average income goes up, so does the tax on these incomes. Again, raising more money for the local government and school districts. See table 1, Variable Definitions, for an explanation of all variable observed.

Table 1. Variable Definitions				
Variable	Explanation	N	Mean	Std. Dev.
Four-year graduation rate	Average four-year graduation rate of the school district for all students	607	3.23723	.0447
Value added grade	The state examines all students state testing and graduation rates and calculates a "value added" grade for each school	607	2.2384868	.0740635
Performance index score grade	Graded on how well the students performed on standardized testing.	607	1.9424342	.0294915
Value per pupil	Districts assessed property value per pupil	607	161039.85	2933.51
Teachers average salary	Average salary off all teachers in the district	607	56858.63	365.3490611
Teachers with 10+ years' experience	Number of teachers with ten plus years of experience	607	.5596705	.0045021
Average income per student	Districts average income per student	607	58862.04	1140.12
State revenue per pupil	Districts state revenue received per pupil	607	6120.55	94.851682
Federal revenue per pupil	Districts federal revenue received per pupil	607	886.1323229	19.1746371
District income tax per pupil	Districts average income tax received per pupil	607	461.8771993	31.1411124
District total property taxes per student	Districts total property tax received per pupil	607	5310.88	121.0271338
Black	Percentage of black students within in the school district	607	.0614168	.0060311
White	Percentage of white students within in the school district	607	.8489127	.0075399
Asian	Percentage of Asian students within in the school district	607	.0111367	.00095391
Hispanic	Percentage of Hispanic students within in the school district	607	.0379736	.0020868

Data

My model looks at all Ohio school districts and all property values within the school district. I am looking to see if average property values have an effect on the local school quality by looking at all local school funding. The variable school quality is the primary dependent variable and the average property value is the primary independent variable. The table below has all the variables used in my research All data was pulled from the Ohio Department of Education and the Ohio Department of Taxation. There are three data sets included (all 2017 and 2018 data) and compiled to get a full data set of all socio-economic data, school quality ranking data, school district property value data, and school spending data.

Results

Looking at a few data points as the independent variable, I ran multiple multivariate OLS regressions looking to give weight to my hypothesis that higher property values raise the school quality. The tables below are a few examples of the results I found. The "Four year graduation rate" is an obvious measure of a schools performance and is used in the first. The US national average for four-year high school graduation is 85%. With Ohio just falling short at an average rate of 84%. (National Center for Education Statistics)
https://nces.ed.gov/programs/coe/indicator_coi.asp

After running a complete correlation table, I found a few different variables that looked promising. The "Four-Year Graduation Rate" and "Value-added grade" were highly correlated with several variables that looked as if they would support the idea that higher property values would be capitalized in better schools. My model is an OLS regression and was ran several times against many variables within the data set to find validation of the hypothesis, four of which are shown and anylised below. The four tables below show typical results found while searching for support of my statement that higher property values raised school values.

Base Model.

Table 2 shows the results of the "base model" regression. "Four year graduation rate" was used as the dependent variable. As you can see with the very low adjusted R square value, that this data is not explaining much of the school four-year graduation rate. With the p value and the T values at <.001 and 5.26 respectively for "Value per pupil", I can reject the null hypothesis.

The coefficient value looks at first. But If the school districts average property value per student was increased by only $3500.00 the four year graduation rate would go up by approximately 1%. And if the Average income of the school districts residents went up by only $2500.00 a year the four-graduation rate would increase by approximately 1%. Neither of these increases are large or out of the realm of possibility for local governments or law makers.

Base Model

Table 2.	Four Year Graduation Rate			
	DF	Estimate (Standard Error)	T-Value	p value
intercept	1	2.37634	24.17	<.0001
		(.09833)		
value per pupil	1	.00000319	5.26	<.0001
		(.000001)		
Average Income Per Student	1	.00000664	4.25	<.0001
		(.00000156)		
Observations	606	F-Value	49.34	
Adjusted R Square	0.1376	Root MSE	0.90917	

Table 3 below shows similar outcomes. This time I was looking at the school districts' "property tax income per student" and the "average income per student" in the school district. Again, very low p values and high enough T values to be confident in rejecting the null hypothesis. The low adjusted r square value of .0845 suggest that this model does little in explaining what raises the quality of school districts four-year graduation rate. But similar results as in Table 2 for the independent variables. This is not surprising as a measure of property value per student and a measure or tax income per student from property value are essentially the same thing. In this model the "Average income per pupil" coefficient is approximately 50 times larger in this model than in Table 2 showing it significant.

Table 3.		Four Year Graduation Rate		
	DF	Estimate (Standard Error)	T-Value	p value
intercept	1	2.63763	27.01	<.0001
		(.09767)		
Total Prop Tax Per Pupil	1	.00008156	5.54	<.0001
		(.00001472)		
Average income Per Pupil	1	.00036042	6.3	<.0001
		(.0000572)		
Observations	606	F-Value	28.97	
Adjusted R Square	0.0845	Root MSE	1.05435	

Expanded Models and Robustness Analysis.

In Table 4, below, I added to the base model several funding sources as additional independent variables. The Adjusted R square value went up to .4156, suggesting this model explains 41.5% of what makes up the "four-year graduation rate". The models T and p values suggest that nothing is statistically significant except for the "Federal Revenue Per Pupil" value. This model shows a strong negative correlation with federal aid to school and the four-year graduation rate. And was common to see Federal revenue negatively correlated with any quality measure in all my regressions. I do not believe the federal rate is the cause of the poor quality. In my research, I have found that poor performing schools will get more federal funding to help improve the children's chances of being successful. Therefore, most likely the school is not performing well before they receive the federal funding.

Expanded Model

Table 4.		Four Year Graduation Rate		
	DF	Estimate (Standard Error)	T-Value	p value
intercept	1	4.91848	25.91	<.0001
		(.18977)		
Total Property Tax Per Pupil	1	-.00003193	-2.08	.0375
		(.00001532)		
Income Tax Per Pupil	1	.00008324	1.73	.0839
		(.00004808)		
State Revenue Per Pupil	1	-.00006832	-2.61	.0093
		(.00002618)		
Federal Revenue Per Pupil	1	-.00128	-11.46	<.0001
		(.00011149)		
Observations	606	F-Value	108.74	
Adjusted R Square	0.4156	Root MSE	0.84238	

I also added teacher salary. As I would expect a better teacher would be paid at a higher rate or a teacher on the job longer would be paid at a higher rate, which does not necessarily mean they are better at their job but they would have more experience as time went on. To begin, I estimated the following model:

$$y = B0 + B1(Value\ \ per\ \ pupil) +\ \ B2(Teachers\ \ average\ \ salary) + B3(State\ \ revenue\ \ per\ \ pupil) + e$$

Table 5 below uses "Value added grade" as the dependent variable. the "value added grade" takes into account the pupils test scores and the districts four-year graduation rate to give a score that takes into account multiple variables. Using several variable to get a "value added score" gives a more clear picture of a student's success as some students may test poorly but accel in other areas. This model added "teacher's average salary" to the formula with "value per pupil" and "state revenue per pupil". As shown all variables and were insignificant with the exception of "State Revenue per Pupil". I believe the state revenue was negative in this model for the same reason the federal revenue was negative in previous models. Schools receive more funding from the state when they are producing poor results.

Table 5.	Value added grade			
	DF	Estimate Standard Error	T-Value	p-value
Intercept	1	3.59021	5.41	<.0001
		(.66401)		
Value per pupil	1	(000)	.34	.732
		(000)		
Teachers average salary	1	-.0001	-.60	.549
		(.00008)		
State revenue per pupil	1	-.0001	-4.67	<.0001
		(.00003)		
Observations	607	F-Value	11.74	
Adjusted R Square	0.0505	Root MSE	1.781	

Conclusion and limitations

I ran many models using different types of property: agricultural, business, industrial, and residential. All property types seemed to have a similar result. I also ran types of property such as Class 1(Residential types properties) and Class 2 (industrial and business type properties). It did show that Class 1 Property, or residential type property, produces better schools. Class 2, or industrial type properties, seem to have a negative effect on school quality. I would hypothesize any negative connotation shown with Class 2 property would be due to people voting with their feet; not wanting to live next to factories and business districts these areas would become less desirable and people would vote with their feet. The more capable workers would move on to higher quality housing with better schools. So again, it is not a cause of poor schools but a symptom.

After running several regressions, my findings confirm that higher property values do create better schools. A show in table 2 and Table 3 the "Four year graduation rate" can be in increased by raising the Average property value per pupil or the average district income per resident by small amounts. This is not hard to do for local governments by adding business or industrial property or promoting more and higher paying jobs. There is weak data suggesting federal or state funding may hurt quality. I believe this is not the cause of the poor performing school as the aid is given to help the school perform better, when in need. It is obvious that the federal and state aid does not resuscitate a struggling school. Every "Federal per pupil" regression had a negative effect on the school quality measure. My next question is, "why does it not help?". I had hoped my analysis would find more convincing evidence on how school quality is affected by local communities' property tax base. How the amount of revenue a school district receives from local property tax dollars would affect the local school district and would give law makers better insight into how to handle a complicated system such as school funding. My results were positive, but it was obvious that more than just funding is needed to rejuvenate a low quality or low performing school. I am confident in stating a schools funding is far from the only thing that establishes its ability perform at the top.

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