Explore the Relationship between School's Educational Quality and Future Crime Rate

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Introduction

Nowadays, controlling the crime rates is increasingly important in this society. This research examines whether the pupil-teacher ratios (PTR) in all public schools as well as private schools at the county level in the United States affect crime rates locally. In order to do this, it will measure the expected difference in crime rates between counties with different ratios through state-level data and then use more precise and county-level data in future regression analysis. The primary purpose of my research is to determine whether higher quality education (lower PTRs) correlates with lower crime rates. Other than educational factors, this research also included economic variables such as per capita income, median household income, and unemployment rates. These factors are in the analyses because they could also significantly influence crime rates (Bernard, 2022).

Some academic papers have contributed to the idea of this research, explaining the connection between education, economic context, unemployment rate, and crime rates. Help to define independent and dependent variables. In “The Effect of Education on Crime: Evidence from Prison Inmates, Arrests, and Self-Reports”, this

paper showed how an increase in formal schooling reduces people's propensity to commit crimes. They also argued that education is a critical factor in shaping decision-making that leads people away from criminal behavior (Lochner & Moretti, 2004). Additionally, Vujić 's and Deming's researches support that opinion. Vujić investigated the relationship between improved educational attainment and property crime reduction. Found that better educational opportunities improve socio-economic prospects and reduce the incentive for committing crimes (Machin et al., 2011)(Bernard, 2022). "Better Schools Less Crime?" reflected that the learners are more unwilling to attend any form of criminal activity. This implies that access to quality education is a powerful instrument for preventing crime amongst them (Deming, 2011).

Furthermore, Kelly explored the basis of crime and pointed out unemployment and income as major factors in the crimes. This is connected to a broader economic context influencing crime, where elements like income inequality have a significant bearing (Kelly, 2000). In addition, Raphael and Winter-Ebmer provided more insight in terms of economic factors and crime. In their study "Identifying the Effect of Unemployment on Crime" revealed a substantial correlation between unemployment rates and crime rates across different districts. They demonstrated that increases in unemployment were linked with the increase in both property crimes and violence. This means that when there are no chances for a legal economy, individuals find themselves driven towards criminal actions due to unemployment stressors. Particularly during periods of economic recession, this correlation becomes more

significant since high crime rates are often accompanied by increased unemployment levels(Raphael & Winter-Ebmer, 2001)(Admin, 2019).

From the analyses below presented, people can learn that counties with better educational environments, be indicated by lower pupil-teacher ratios, generally experience lower crime rates. This relationship holds even after controlling the economic factors such as income and unemployment. Moreover, the differentiation between public and private schools impacts on crime rate revealing that improving public school's educational quality might be more effective in decreasing future crime rates. This outcome could offer valuable insights for government and policymakers to enhance public safety and improve community well-being.

In the following paragraphs, I will present and elucidate visualizations, summary statistics, and regression models. Aims to deliver a comprehensive and detailed result.

Data

The data table below is named ‘final_data’. This table contains all X and Y variables I want (I just show the first 5 rows of this table).

```
final_data.head()
```

	COUNTY	STATE	unemployment rate	county crime rate	Private_PTR	Public_PTR	per capita income	median household income
0	ABBEVILLE	SC	4.2	511.856680	7.850000	13.242189	18134	35947
1	ACADIA	LA	5.4	163.976593	14.490378	20.080976	19910	37587
2	ACCOMACK	VA	4.1	190.056715	11.000000	15.921038	22703	39328
3	ADA	ID	2.4	206.500442	9.621437	18.674659	27452	55210
4	ADAIR	OK	4.4	310.894836	11.150000	12.714123	15116	32556

In this study, the observations are about three thousand due to they all are county-level data. Let’s explain their meaning and the reason why include them. The

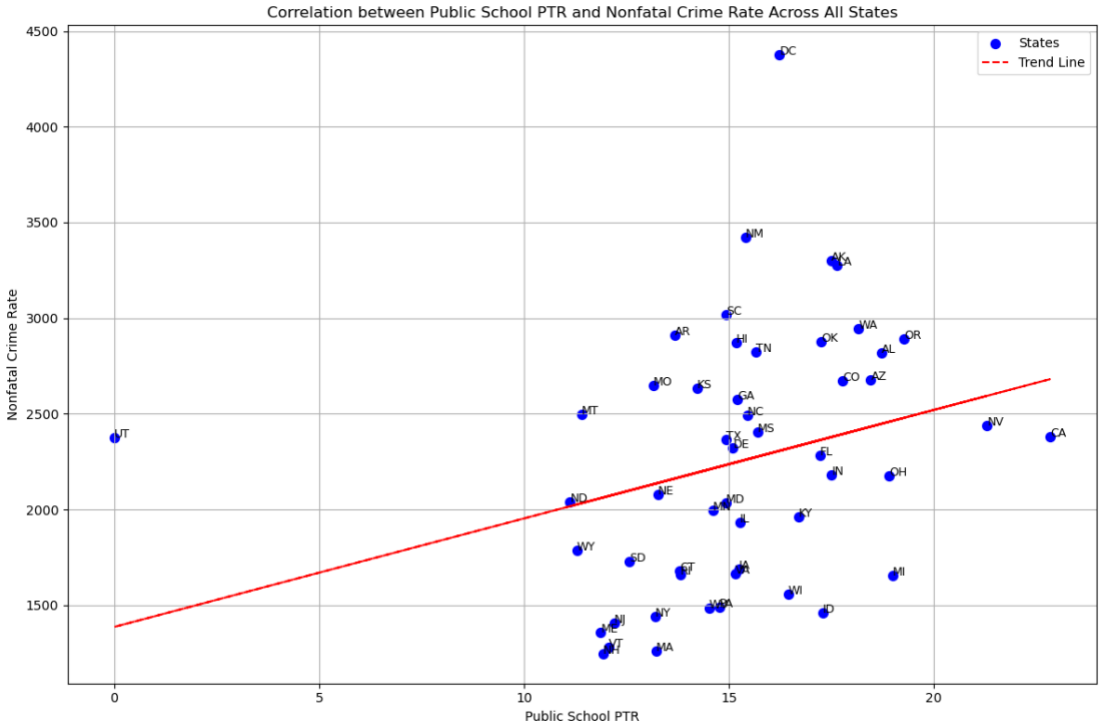
dependent variable (Y) is the crime rate in each county, which is an indicator of the county's safety level. Finding out the economic facts about the crime rate is important and valuable due to it can help improve the well-being of all citizens. This data comes from Kaggle (JOHNSON JR, 2017).

The independent variables (X) include Public_PTR: It stands for the pupil-teacher ratio in public schools. I set this for evaluating the educational quality. Private_PTR: In order to investigate the potential differences in impact on local crime rates between private and public schools. I include both 'Public_PTR' and 'Private_PTR' as separate x variables. This differentiation aims to figure it out which is better on influencing crime rate. These two important X is coming from the website the professor provided (LARXEL, 2020). Income per capita: This variable is included as a controller in my future regression. Income levels have a considerable influence on crime rates, particularly non-fatal crimes such as theft. Median household income: I also consider median household income to ensure comparisons between counties of similar economic statuses, as counties with lower median household income possibly have higher crime rates. Getting both income data from web scraping Wikipedia (*List of United States Counties by per Capita Income*, 2024). Unemployment rate: As another control variable(x), the unemployment rate is included based on it is well-known that can significantly affect local crime rates. It also comes from Kaggle (AGUAYO, 2019).

This comprehensive approach incorporating economic dimensions allows for a more detailed exploration of the factors influencing crime rates across different

counties. This study can evaluate and underscore the importance of the quality of education by revealing how PTR affects the future local crime rate.

Summary statistics

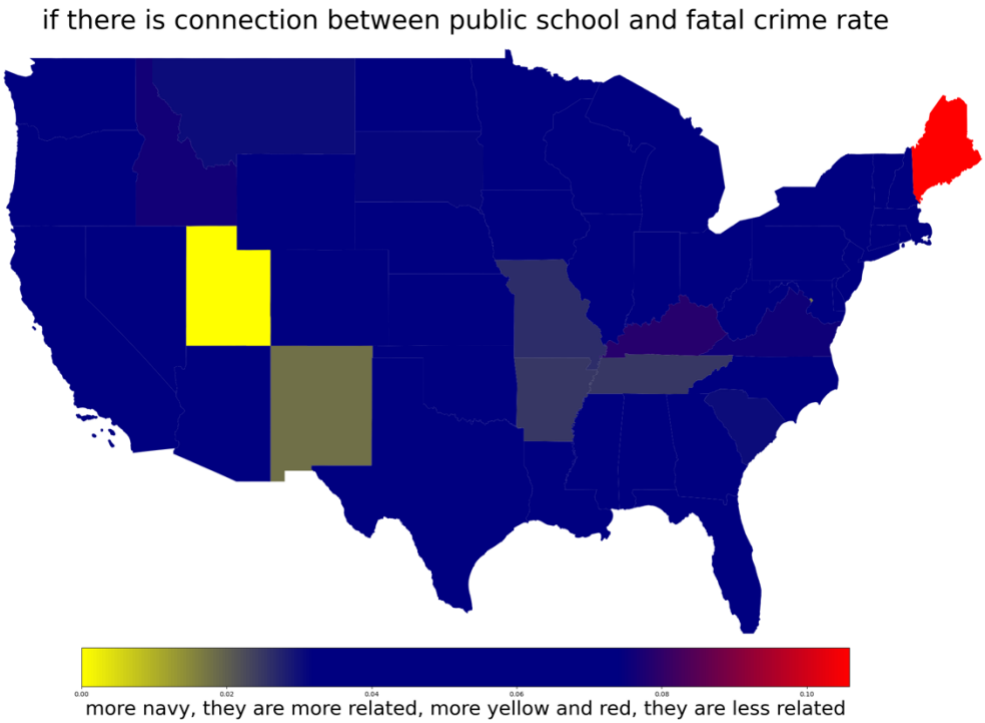


This plot visualized the research's initial finding: The linear relationship between educational quality and crime; worse school quality with a higher crime rate, vice versa.¶ It charts the quality of public schools on the X axis and the nonfatal crime rate on the Y axis, allowing us to trace a trend line through these points. Observing that the slope of the trend line is upward indicates a clear pattern: states with high public school PTR tend to have higher nonfatal crime rates. This visual evidence supports the main message of my analysis, suggesting a link between the quality of education and crime rates across the states.

What's more, the following map can demonstrate this initial finding. I've created a ratio called 'value' by dividing PTR by crime rate, based on data from each state.

This approach is designed to quantify the relationship between PTR and the crime rate within each town. Our hypothesis suggests that a higher PTR correlates with a higher crime rate, and vice versa. Essentially, if a state's 'value'—derived from this calculation—is close to the median value across all states, it supports our assumption.

To visually represent this data, I created this map. Coloring each state based on how its 'value' compares to the median. States with values close to the median are colored navy, indicating a direct connection between school populations and crime rates as per our hypothesis. States that deviate more significantly from the median are marked in red or yellow. The prevalence of navy across all maps further validates our initial hypothesis, showing there is a significant relationship between educational quality and crime rates.



Results

Base on the economic theory and the initial finding, we will try to compare the linear models and nonlinear models to see which fit better into the data. However, from the economic tuition, non-linear relationship makes more sense due to if we want to decrease crime rate a lot, we cannot just always improve the educational quality. We can use the concept of diminishing returns, a well-known economic theory to explain. This theory suggests that after a certain point, each additional unit of input (in this case, investment in education) yields less and less output (reduction in local crime rates). At first, increasing educational quality might greatly reduce crime rates, but over time, the amount of crime reduction gained from each additional improvement becomes smaller. This shows that although enhancing education is beneficial, relying solely on this approach without other supportive measures may not always be effective. ¶

	Dependent variable: county crime rate			
	(1)	(2)	(3)	(4)
Private_PTR	0.339	4.770	1.253	7.680**
	(1.253)	(3.160)	(1.217)	(3.071)
Private_PTR_squared		-0.184*		-0.260**
		(0.111)		(0.108)
Public_PTR	6.758***	20.586***	6.925***	21.617***
	(1.408)	(4.421)	(1.387)	(4.346)
Public_PTR_squared		-0.358***		-0.380***
		(0.106)		(0.104)
const	162.924***	15.960	137.689***	-20.133
	(23.614)	(45.318)	(35.042)	(50.523)
median household income			-0.007***	-0.007***
			(0.001)	(0.001)
per capita income			0.011***	0.012***
			(0.002)	(0.002)
unemployment rate			18.188***	17.141***
			(3.568)	(3.568)
dummies	No	No	No	No
Observations	2255	2255	2255	2255
R^2	0.010	0.017	0.072	0.080
Adjusted R^2	0.010	0.015	0.070	0.077
Residual Std. Error	212.695 (df=2252)	212.099 (df=2250)	206.104 (df=2249)	205.275 (df=2247)
F Statistic	11.902*** (df=2; 2252)	9.656*** (df=4; 2250)	34.938*** (df=5; 2249)	28.045*** (df=7; 2247)
Note:				*p<0.1; **p<0.05; ***p<0.01

Running these four models (this first regression table) for comparing linear model to the nonlinear regression model in order to figure out which type of regression is better. The linear relationship is my original assumption. And non-linear regression is based on economic theory (diminishing marginal return) and the fact from my data plots. From the table, we can clearly see that the R^2 value is better in the non-linear models, which indicates a better fit. More importantly, the coefficients for both types of PTR (pupil-teacher ratio) in the non-linear regression are much improved compared to the linear regression. Also, the p-value for Private_PTR in the non-linear regression is significant, unlike in the linear regression, suggesting that it is a reliable factor in this model. Overall, nonlinear regression(X^2) is better (How to Choose between Linear and Nonlinear Regression Models?, n.d.).

	(1)
const	-65.718
	(95.678)
Private_PTR	14.306***
	(2.779)
Public_PTR	38.317***
	(4.589)
Private_PTR_squared	-0.402***
	(0.096)
Public_PTR_squared	-0.647***
	(0.099)
unemployment rate	12.150***
	(4.045)
per capita income	0.013***
	(0.001)
median household income	-0.008***
	(0.001)
dummies	Yes
Observations	2255
R^2	0.337
Adjusted R^2	0.320
Residual Std. Error	176.246 (df=2199)
F Statistic	20.281*** (df=55; 2199)

Based on the comparison of regression models; I chose the regression above. **This regression provided a lot of meaningful, valuable answers for this research.** The high positive coefficients for public and private PTR suggest that improving educational quality (by decreasing PTR) can significantly reduce crime rates. However, you can see the negative coefficient for PTR squared. This is due to 'diminishing marginal returns'. This means we can't keep lowering PTR to reduce the crime rate to zero—it's not feasible. When increasing X to a point, Y will start to decrease instead of increase. Additionally, the positive coefficients for the unemployment rate is easy to explain. As many would expect, this factor can significantly impact crime rates. Regarding the small negative coefficient for median household income, I believe it's because thefts often target wealthier people, leading to a slight increase in crime rates in richer areas. However, increased household income generally lowers the crime rate as well because people are less likely to commit crimes when they are financially secure. This balance results in a very small negative coefficient. The logic is similar for per capita income. Therefore, both of their coefficients are small. Overall, the correlation between educational quality and the local crime rate is non-linear (X^2). At first, increasing educational quality can decrease the crime rate. However, after attaining a point; it will not work even increasing the crime rate(How to Estimate the Regression Coefficients and Assess the Model Fit, n.d.).

Conclusion

This study has addressed the economic question of how pupil-teacher ratios

(PTR) in public and private schools at the county level influence local crime rates. The main findings have reflected significant distinctions between the impacts of public and private school PTRs on crime rates, and highlighting that improvements in public school educational quality are more closely correlated with reductions in crime. This insight differentiates this paper from other literature, which often focuses more broadly on education without distinguishing types of schools. Additionally, this research reveals a non-linear relationship: an inverted U-shaped curve. This is completely different from other academic papers. Initially, as X increases, there is a corresponding rise in Y. This initial phase reflects a positive relationship between X and Y. However, after reaching a critical threshold, further increases in X begin to yield diminishing returns. Beyond this point, the relationship reverses—continuing to increase X results in a decrease in Y. Meeting the diminishing marginal returns, an **economic principle** shows that while initial increments of X contribute positively, each subsequent increase in X becomes less effective, and eventually counterproductive (X is educational quality. Y is crime rate). Future research will aim to figure out and identify the specific point before the relationship reverses. In other words, to determinate the optimal public and private pupil-teacher ratios (PTR) that reduce the crime rate most in each region (Hayes, 2022).

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