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Effects of Spending on New York Counties Six Year Graduation Rate

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An Abstract of a Thesis
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Buffalo State College
State University of New York
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Abstract

This study set out to find out more about the costs and benefits of educational spending. This was goal was then split into the steps of: reviewing previous literature, developing a model, and testing the model. The main difficulties associated with this were in finding appropriate substitutes for the theoretical variables. Due to the limited availability of data, this study focused on the six-year high school graduation rate of New York State Counties, class size, income, and spending per student as variables. These variables represented educational level, a portion of the efficiency of spending, the parent's ability to help educate their children, and both the short and long-term spending of schools respectively.

The results were that spending per students was not significant. This was likely due to the low variability between counties, potential errors in data collection, and the multicollinearity associated with combining multiple variables in the theoretical model. Class size was found to require income to be in the model in order be significant. This points to income potentially containing part of the short-term and/or long-term spending component of the theoretical model, making income a poor substitute.

The suggestions for future studies are to: avoid the poor substitutes found by this study, reduce the level of aggregation by looking at either a school or district level, as well as looking through the theories for other substitutes to use and acquiring more data if possible.

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Introduction

Mankind has always built upon the accomplishments of those that came before. This can be seen from a range of activities as basic as parents teaching children how to accomplish simple things like dressing themselves all the way to surgeons learning from experienced doctors through residency. The fact that knowledge needs to be learned from others, be it directly through teaching or indirectly through activities such as reading, and that this knowledge can be potentially useful to both the individuals learning it and the society benefitting from it is self-evident. That said learning is not without cost. There is time spent teaching, learning, and creating materials to learn from.

With that in mind, when there is a cost and a benefit it is natural to wonder about the best way to deal with the situation. While there are many social arguments and moral issues to consider, those are better left to other fields to figure out. This paper will try to find out more about the costs and benefits of educational spending by looking at the graduation rates of the counties in New York State and analyzing the possible factors which could influence it. With this we should understand the issue a bit better and hopefully be able to take a step towards finding the best course of action to take in optimizing the educational system.

This study will begin with reviewing the literature, both theoretical and empirical. This step is crucial because perfect data will likely be impossible to get, causing substitutions and ways to work around issues to be required to set up a model. By incorporating the research of others on this topic, and analyzing their findings and methodology, the issues that they found, the information they gleaned, and the way they worked around issues becomes apparent. Once sufficiently armed with information a

theoretical model can be created. This will point to what data needs to be collected. Unfortunately, this data will most likely be impossible to collect. This creates a need to find substitutes for many of the variables. With the substitutes decided on and the data on them gathered regression can be run on SAS. This analysis of this regression will allow the gleaning of information. It will show what worked well, what did not work well, and what substitutes were applicable. This ultimately leads to the cycle of research to begin anew.

Review of Literature

Firstly, we must confirm that education does, in fact, increase how much you produce and earn. Previous studies have shown that as your education increases your wages also increase.[1] In addition, people with more education tend to be more productive.[2] While education increases both wage and productivity, the increase in wage is greater related to education than to productivity. The issue is that the relationship between a person's degree of education and their wage is greater than the relationship between their productivity and their degree of education.[3]

Luckily this effect seems to be mitigated by an undiscovered factor in relatively "free" and democratic countries.[4] This effect shows that there may be cases where education is not fully utilized for increased productivity and instead serves mainly as a credential to get a job. Since this study will be focused on the United States, a relatively free and democratic nation, this effect will not be the focus of this paper. With this we have an understanding that the relationship we are looking for exists and is likely positive, but already a potential issue has surfaced.

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[1] Mauricio Armellini, "The Democratic Factor in the Education-Growth Relationship," Kyklos, August, 2012, accessed April 1, 2016,http://proxy.buffalostate.edu:3528/ehost/pdfviewer/pdfviewer?sid=4422168b-f14e-4384-9810-63f9095e68f1%40sessionmgr115&vid=1&hid=127.

[2] Michelle Bensi, David Black, and Michael Dowd, "The Education/growth Relationship: Evidence from Real State Panel Data," Business Insights, 2004, accessed April 1, 2016, http://proxy.buffalostate.edu:2264/essentials/article/GALE%7CA115930311?u=nysl_we_bsc&sid=summon&userGroup=nysl_we_bsc

[3] Mauricio Armellini, "The Democratic Factor in the Education-Growth Relationship," Kyklos, August, 2012, accessed April 1, 2016, http://proxy.buffalostate.edu:3528/ehost/pdfviewer/pdfviewer?sid=4422168b-f14e-4384-9810-63f9095e68f1%40sessionmgr115&vid=1&hid=127.

[4] Mauricio Armellini, "The Democratic Factor in the Education-Growth Relationship," Kyklos, August, 2012, accessed April 1, 2016,http://proxy.buffalostate.edu:3528/ehost/pdfviewer/pdfviewer?sid=4422168b-f14e-4384-9810-63f9095e68f1%40sessionmgr115&vid=1&hid=127.

With this issue identified, we can look at some historical events to deepen our understanding. Firstly, human capital has been shown to be a driving force in economic growth.[5] That said there are also other factors. You can also achieve growth in gross domestic product through utilizing "rent" activities.[6] The latter includes things such as utilizing natural resources and the land. Adding further complications to the educational effect is not only a simple increase in a worker's productivity, but also an increase in innovative capacity.[7] With other sources of gross domestic product growth and the unpredictable growth in new technologies added to the picture it becomes significantly more challenging to measure the effects of increased education. However, one source indicates that, many of the differences in countries growth rates can be found by looking at differences in international test scores.[8] Unfortunately, these international tests are not a large focus in schools. This causes the sample size to decrease and to potentially skew if some countries intentionally prepare students to take these tests while others do not. Of course, the ethics and practicality of teaching to the test rather than teaching for

[5] Yousif Al-Yousif, "Education Expenditure and Economic Growth: Some Empirical Evidence from the Gcc Countries," *The Journal of Developing Areas* 42, no. 1 (Fall 2008): under "Economics," accessed April 1, 2016, http://proxy.buffalostate.edu:2251/journals/journal_of_developing_areas/v042/42.1.al-yousif.html.

[6] Yousif Al-Yousif, "Education Expenditure and Economic Growth: Some Empirical Evidence from the Gcc Countries," *The Journal of Developing Areas* 42, no. 1 (Fall 2008): under "Economics," accessed April 1, 2016, http://proxy.buffalostate.edu:2251/journals/journal_of_developing_areas/v042/42.1.al-yousif.html.

[7] Alvina Idrees and Muhammad Siddiqi, "Does Public Education Expenditure Cause Economic Growth? Comparison of Developed and Developing Countries,"*Pakistan Journal of Commerce and Social Sciences* 7 (2013): 1, accessed April 1, 2016, http://proxy.buffalostate.edu:3531/ehost/pdfviewer/pdfviewer?sid=bebd0a21-03ed-4763-844b-b32095034a2c%40sessionmgr114&vid=1&hid=118.

[8] Eric Hanushek, "Higher Grades, Higher Gdp: The Stronger the Student Performance, the More Prosperous the Nation," *Hoover Digest* (Winter 2014): 1, accessed February 25, 2016, http://proxy.buffalostate.edu:2255/ic/ovic/AcademicJournalsDetailsPage/AcademicJournalsDetailsWindow?failOverType=&query=&prodId=&windowstate=normal&contentModules=&display-query=&mode=view&displayGroupName=Journals&dviSelectedPag.

maximum knowledge growth are controversial, but the effect could, obviously, affect the results.

While it is convenient to simplify education to a basic function of time and money spent, in the real world the situation is far more complex. This can be clearly seen when looking at developing countries education. In this sector, some countries, such as China and Korea, do well on internationally comparable tests while other countries' students do little better than guessing.[9] This wide variance shows that there are several factors at work that are potentially even more important than spending on education. This causes it to become necessary to explore the mechanics underlying education that could potentially cause this disparity.

With that debate noted, we are free to examine more potential issues that should be recognized and controlled if possible. Many have looked down on educational spending because the taxes needed for it counteract the good it produces.[10] While it is true that taxes can have negative effects on the economy, different kinds of taxes affect the economy differently. In addition, they can affect the economy in unexpected ways, and so too can the spending itself. This is because, in the case of an increased educational spending, the individual's return from education increase, thusly; causing him or her to invest more time and money into education.[11] This increase in the effort

[9] Lant Pritchett and Deon Filmer, "What education production functions really show: a positive theory of education expenditures," *Economics of Education Review* 18, no. 2 (April 1999): 223-39, http://www.sciencedirect.com/science/article/pii/S027277579800034X (accessed January 14, 2017).

[10] William Blankenau, Nicole Simpson, and Marc Tomljanovich, "Public Education Expenditures, Taxation, and Growth: Linking Data to Theory," Jstor, May, 2007, accessed April 1, 2016, http://proxy.buffalostate.edu:2096/stable/30034482?seq=1#page_scan_tab_contents.

[11] Yazid Dissou, Selma Didic, and Tatsiana Yakautsava, "Government spending on education, human capital accumulation, and growth," *Economic Modelling* 58 (November 2016): 9-21, http://www.sciencedirect.com/science/article/pii/S0264999316301067 (accessed January 14, 2017).

spent acquiring human capital has several effects in and of itself. The increased value of human capital and the demand for education it creates causes tuition prices to rise.[12] In addition, this increased individual investment into education reduces the short-term consumption.[13] With a short term drop in consumption and a long run increase in tuition prices education an argument that educational spending changes are futile could be made. Luckily, there is another factor involved: the government. The long run effect of increased tuition prices is significantly reduced by public schooling, while the short run effect could potentially be controlled for with taxes. That said, not all schooling is public and taxes that reduce the initial consumption loss may not be ideal in all circumstances. With that in mind, to avoid the long term affect by providing schooling money would need to be raised through taxes to pay for it.

It is well known that taxes slow an economy and create some degree of dead weight loss through their implementation. Fortunately, they also come in a variety of forms. Using these different forms of taxes, we can structure them in a way that can reduce some undesired shocks in a system. In the case of educational spending these shocks are a short-term increase in educational demand from time spent in education becoming more valuable, a short term decrease in consumption to fund the increase in time spent acquiring education, and long run increases in tuition and the value of

[12] Bradley Curs, Bornali Bhandari, and Christina Steiger, "The Roles of Public Higher Education Expenditure and the Privatization of the Higher Education On U.S. States Economic Growth," *Journal of Education Finance* 36, no. 4 (Spring 2011): under "Education," accessed November 15, 2015,http://proxy.buffalostate.edu:2251/journals/journal_of_education_finance/v036/36.4.curs.html.

[13] Yazid Dissou, Selma Didic, and Tatsiana Yakautsava, "Government spending on education, human capital accumulation, and growth," *Economic Modelling* 58 (November 2016): 9-21, http://www.sciencedirect.com/science/article/pii/S0264999316301067 (accessed January 14, 2017).

financial capital.[14] A few important notes in this are that the increased tuitions are only indirectly felt in the case of public schooling and that the effect of less time working lowering wages becomes a larger factor as people age and grow their human capital. To put this in plainer terms, while a twelve-year-old could potentially do some jobs, they would not be nearly as productive as a high school graduate and sending them to work that young in the first place would generally be viewed as morally wrong. As a great deal of schooling happens during these early years, public schooling until college is predominately government provided the effects of these shocks is inherently minimized in pre-college schooling, that said they are a larger factor in higher education.

The most obvious way to fund education is to use a labor tax to take advantage of the increased productivity that education provides. The downside of labor taxes is that they reduce the value of education, and thusly lower the power of all four effects of increasing education in the first place; however, it has been shown that increasing education still has value despite the reduced effectiveness.[15] Another method for raising money for education would be to tax the increased value of financial capital that results from education. This is obtainable through a capital tax, which reduces the value of education to employers indirectly making education and work in general less valuable, which encourages more time spent on leisure.[16] Promoting leisure over work and

[14] Yazid Dissou, Selma Didic, and Tatsiana Yakautsava, "Government spending on education, human capital accumulation, and growth," *Economic Modelling* 58 (November 2016): 9-21, http://www.sciencedirect.com/science/article/pii/S0264999316301067 (accessed January 14, 2017).

[15] Yazid Dissou, Selma Didic, and Tatsiana Yakautsava, "Government spending on education, human capital accumulation, and growth," *Economic Modelling* 58 (November 2016): 9-21, http://www.sciencedirect.com/science/article/pii/S0264999316301067 (accessed January 14, 2017).

[16] Yazid Dissou, Selma Didic, and Tatsiana Yakautsava, "Government spending on education, human capital accumulation, and growth," *Economic Modelling* 58 (November 2016): 9-21, http://www.sciencedirect.com/science/article/pii/S0264999316301067 (accessed January 14, 2017).

education cuts consumption and output in both the short and long term making this a bad option for funding education. A middle ground between these choices is taxing output. In practice, this middle ground approach functions somewhere in between labor and capital taxes in efficiency.[17] Of the three kinds of taxes that effect the results of education, the labor tax appears to be the best option. That said, it still reduces the effectiveness of education so funding in a way that does not affect this system would be ideal.[18] Additionally, there are a large amount of possible taxes outside of this system and they all have their own benefits and drawbacks. While this thesis will not be focused on taxes, there is an opportunity to expand the real-world usability of any results found herein with a future study into taxes.

Another issue is the potential to crowd out private spending. This is a factor because the government is far from the only provider of education. Many non-profit, not for profit and even for profit institutions exist that provide educational services. Ignoring the moral good parts and bad parts of the private sector of education, it stands to reason that increasing the level of public education can potentially shrink their market share, due to crowding out. Some studies have found that when your account for this crowding out effect that an increase in government spending on education does not affect the level of education to a significant degree.[19] In addition, it has been shown that growth estimates

[17] Yazid Dissou, Selma Didic, and Tatsiana Yakautsava, "Government spending on education, human capital accumulation, and growth," *Economic Modelling* 58 (November 2016): 9-21, http://www.sciencedirect.com/science/article/pii/S0264999316301067 (accessed January 14, 2017).

[18] Bradley Curs, Bornali Bhandari, and Christina Steiger, "The Roles of Public Higher Education Expenditure and the Privatization of the Higher Education On U.S. States Economic Growth," *Journal of Education Finance* 36, no. 4 (Spring 2011): under "Education," accessed November 15, 2015,http://proxy.buffalostate.edu:2251/journals/journal_of_education_finance/v036/36.4.curs.html.

[19] William Blankenau, Nicole Simpson, and Marc Tomljanovich, "Public Education Expenditures, Taxation, and Growth: Linking Data to Theory," Jstor, May, 2007, accessed April 1, 2016, http://proxy.buffalostate.edu:2096/stable/30034482?seq=1#page_scan_tab_contents.

on higher education that ignore the private educational system end up with negatively biased results.[20] Accounting for these issues would help the study, but doing it properly may prove challenging as private educational spending is harder to collect data on and is likely affected by more factors than just government educational spending.

One of the factors that makes comparing different countries educational systems difficult is the effect of teachers on education. In this area, the largest debate seems to be on how efficient it is to pay teacher's high wages. On this matter, Caroline Minter-Hoxby (1996) found that high spending on teacher salaries was inefficient when comparing unionized and non-unionized school districts.[21] On the other side, Murnane et ai (1991) and Bailou and Podgursky (1997) found that competitive wages were necessary to attract skilled teachers.[22] This finding was reinforced by studies by Odden, Kelley, Dolton, and Klaauw showing that compensation levels affect who goes into teaching and how long they stay.[23] Hanushek (1986), Grogger (1996) and Betts (1995) solved a piece of this puzzle when they found that salaries do not play a significant role in pupil outcomes because different school districts face different supply curves.[24] This

[20] Bradley Curs, Bornali Bhandari, and Christina Steiger, "The Roles of Public Higher Education Expenditure and the Privatization of the Higher Education On U.S. States Economic Growth," *Journal of Education Finance* 36, no. 4 (Spring 2011): under "Education," accessed November 15, 2015,http://proxy.buffalostate.edu:2251/journals/journal_of_education_finance/v036/36.4.curs.html.

[21] Lant Pritchett and Deon Filmer, "What education production functions really show: a positive theory of education expenditures," *Economics of Education Review* 18, no. 2 (April 1999): 223-39, http://www.sciencedirect.com/science/article/pii/S027277579800034X (accessed January 14, 2017).

[22] Peter Dolton et al., "If you pay peanuts do you get monkeys? A cross-country analysis of teacher pay and pupil performance," *Economic Policy* 26, no. 65 (January 2011): 7-55, http://proxy.buffalostate.edu:2074/stable/pdf/41261999.pdf (accessed February 21, 2017).

[23] Lant Pritchett and Deon Filmer, "What education production functions really show: a positive theory of education expenditures," *Economics of Education Review* 18, no. 2 (April 1999): 223-39, http://www.sciencedirect.com/science/article/pii/S027277579800034X (accessed January 14, 2017).

[24] Peter Dolton et al., "If you pay peanuts do you get monkeys? A cross-country analysis of teacher pay and pupil performance," *Economic Policy* 26, no. 65 (January 2011): 7-55, http://proxy.buffalostate.edu:2074/stable/pdf/41261999.pdf (accessed February 21, 2017).

realization makes any educational spending metrics comparing different countries school district efficiencies challenging, especially if they are countries with drastically different economic situations. In addition, this issue can be seen even locally to a lesser degree because different areas can have different amounts of teachers and different average wages even within a state. When put together, the logical conclusion is that the relative wage of teachers is far more important than their absolute wages. This logical conclusion is reinforced by Loeb and Page (2000) study that found that a ten percent increase in relative teacher wages was correlated with a three to six percent reduction in the high school drop-out rate.[25] Unfortunately, the complications do not end here.

A further complication is caused by teaching licenses allowing the teaching of subjects outside of their specialty. Goldhaber and Brewer (1997) highlighted this issue when they found that, when looking at eighth grade math scores, students of teachers who had majored in math performed significantly better on exams while there was no significant effect of the teacher having more experience teaching.[26] This makes sense for two reasons: the teacher who studied math in school has significantly more experience on the subject and the teacher who studied math is likely more passionate about the subject matter. It is obvious that teachers teaching subjects they did not specialize in is a misallocation of resources and that differing degrees of misallocation resources can complicate the model further. The obvious solution to this is to simply require teachers to teach what they specialized in, but such a law could have unintended consequences;

[25] Lant Pritchett and Deon Filmer, "What education production functions really show: a positive theory of education expenditures," *Economics of Education Review* 18, no. 2 (April 1999): 223-39, http://www.sciencedirect.com/science/article/pii/S027277579800034X (accessed January 14, 2017).

[26] Peter Dolton et al., "If you pay peanuts do you get monkeys? A cross-country analysis of teacher pay and pupil performance," *Economic Policy* 26, no. 65 (January 2011): 7-55, http://proxy.buffalostate.edu:2074/stable/pdf/41261999.pdf (accessed February 21, 2017).

especially in the short term. The initial shock could be mitigated by grandfathering teachers into their existing roles, but future teaching positions would be more difficult to fill. Additionally, there is a potential that there is currently an imbalance between what teachers specialize in. This could lead to the need to pay teachers of certain subjects more to incentivize them to teach it as the supply of teachers dwindles in those subjects. With re-specializing being costly and time consuming, any imbalances could take a long time to resolve. Both factors make comparing different school districts significantly more challenging. Luckily there is an easy method for avoiding the need to micro-manage these issues on a macro-scale: local governments.

Frustratingly, giving a person the tools to succeed does not guarantee they will use those tools. This can be seen by a growth in America's high school dropout rates despite a high level of educational spending.[27] In addition, international test scores have been shown to matter more than the number of years in school.[28] This makes sense because in the end the amount of knowledge acquired is more important than how long you were in school. Together these both add to the error term.

[27] Eric Hanushek, "Higher Grades, Higher Gdp: The Stronger the Student Performance, the More Prosperous the Nation," *Hoover Digest* (Winter 2014): 1, accessed February 25, 2016, http://proxy.buffalostate.edu:2255/ic/ovic/AcademicJournalsDetailsPage/AcademicJournalsDetailsWindow?failOverType=&query=&prodId=&windowstate=normal&contentModules=&display-query=&mode=view&displayGroupName=Journals&dviSelectedPag.

[28] Eric Hanushek, "Higher Grades, Higher Gdp: The Stronger the Student Performance, the More Prosperous the Nation," *Hoover Digest* (Winter 2014): 1, accessed February 25, 2016, http://proxy.buffalostate.edu:2255/ic/ovic/AcademicJournalsDetailsPage/AcademicJournalsDetailsWindow?failOverType=&query=&prodId=&windowstate=normal&contentModules=&display-query=&mode=view&displayGroupName=Journals&dviSelectedPag.

Next, we have the complications that come from measuring education itself. One is that the way education funding is spent is more important than how it is spent.[29] This makes sense because it recognizes that there is a potential to waste money due to improper spending and not all spending increases education to the same degree or distributes the same way. A theoretical example of this would be a company ordering its potential projects based on profitability and doing the best project available until it runs out of money while skips the remaining projects available to it. In this perfect world case, it would cause diminishing returns, but the real world is much more complicated. Only competent management can do this project spending perfectly and even then, there can be complications such as projects being dependent on other projects, errors in forecasting results, or unexpected expenses of projects. Further support for a diminishing return can be seen when researching developing countries. This research has shown a far greater affect from increased educational spending than developed countries with Idrees and Siddiqi's research showing the effects of a one dollar increase in education to GDP falling from 27.29 to 21.85 dollars.[30] Between these two arguments there is support for a potential diminishing return to educational spending.

Data access is not necessarily a simple task. There are many ways to measure both the input and the output. For instance, there do you measure economic spending or

[29] Norman Baldwin and Stephen Borrelli, "Education and economic growth in the United States: cross-national applications for an intra-national path analysis," Springer Science and Business Media,, July, 2008, accessed April 1, 2016, http://proxy.buffalostate.edu:2324/article/10.1007/s11077-008-9062-2/fulltext.html.

[30] Alvina Idrees and Muhammad Siddiqi, "Does Public Education Expenditure Cause Economic Growth? Comparison of Developed and Developing Countries,"*Pakistan Journal of Commerce and Social Sciences* 7 (2013): 1, accessed April 1, 2016, http://proxy.buffalostate.edu:3531/ehost/pdfviewer/pdfviewer?sid=bebd0a21-03ed-4763-844b-b32095034a2c%40sessionmgr114&vid=1&hid=118.

teacher ratios, and do you measure graduation rates or standardized test scores[31]? In theory any combination of these should work, but many factors lead your results to vary drastically depending on your approach in the real world. To truly do this correctly you would, likely, need to perform experiments to find the optimal spending breakdown between the different factors needed to educate (such as amount spent on teacher number, teacher quality, textbooks, learning technology, and the building itself). To do this, obtaining a group of similar schools and manipulating their budgets while holding as many factors constant as possible would be required. With that controlled for you could at least simply use spending as your independent variable. That said, this approach has three issues. Firstly, this experiment would be a large undertaking that would be not only expensive to perform, but also difficult to control as you are dealing with several heterogeneous parts, such as individual teachers and individual students aptitudes. The heterogeneity issue could be reduced through using a large sample size, but this would magnify the expense side of the issue.

The second issue with this kind of experiment is the ethical implications of dealing with children. As results begin to come in there would likely be public and parental outcry to change the conditions of the students in the underperforming sections that would likely force the study to either end prematurely or accept having incomplete results that could skew the results. This issue could be reduced through choosing

[31] Norman Baldwin and Stephen Borrelli, "Education and economic growth in the United States: cross-national applications for an intra-national path analysis," Springer Science and Business Media, July, 2008, accessed April 1, 2016, http://proxy.buffalostate.edu:2324/article/10.1007/s11077-008-9062-2/fulltext.html.

students from the worst schools to participate, but this could skew the results and would only reduce the issue not eliminate it.

A final issue with the controlled study is that education level is not a measurable variable and the proper substitute to use is highly debatable. Some examples of these substitutes would be grades, graduation rates, future education level obtained, future income, and productivity. While such a controlled experiment would be wildly unpractical and quite likely unethical to perform, this thought exercise does reveal potential issues that could affect more standard approaches. While the cost and ethical concerns are reduced, changing the methods a school uses will cause it to come under scrutiny. If this scrutiny shows negative short-term effects, the change will likely be reverted before the long-term effects are known. This creates a certain amount of homogeneity as schools do not want to be too different from those around them.

Some final notes on the literature that will not affect the model much but will affect its meaning. First, there is a lot of debate whether educational growth causes economic growth or if it's the other way around.[32] As econometrics cannot prove causation anyway this is not a huge factor in developing a model, but it warrants extra caution when looking at the results. Finally, while the theory shows strong support for

[32] Yousif Al-Yousif, "Education Expenditure and Economic Growth: Some Empirical Evidence from the Gcc Countries," *The Journal of Developing Areas* 42, no. 1 (Fall 2008): under "Economics," accessed April 1, 2016, http://proxy.buffalostate.edu:2251/journals/journal_of_developing_areas/v042/42.1.al-yousif.html.

educational expenditure leading to economic growth, empirical studies tend to be mixed, wherein some support it and others go against it.[33]

[33] William Blankenau, Nicole Simpson, and Marc Tomljanovich, "Public Education Expenditures, Taxation, and Growth: Linking Data to Theory," Jstor, May, 2007, accessed April 1, 2016, http://proxy.buffalostate.edu:2096/stable/30034482?seq=1#page_scan_tab_contents.

Data

To control for differences in state educational systems this paper will focus on New York State. With the scope of the study in mind, the focus could be on schools, districts, or counties. Because data is limited on many of the factors explored thus far, the focus will be on counties in the hope that taking the aggregate of success in each would control for these factors to a degree.

With variables outside the scope controlled for by focusing on New York State counties, the next decision was what data to obtain. For the amount that a parent teaches their children, income will serve as an imperfect stand-in. Income was chosen because it is a measure of how hard an employee would be to replace and the value of their work. Due to this, high-income individuals will tend to have a high amount of education, be it from school or learned on the job, and having obtained it themselves will likely value knowledge. This is far from a perfect substitute as it neglects to account for lower income individuals who want to see their children have a better life and work hard to educate them, but it is measurable and easy to find data on. The data for this came from the Bureau of Economic Analysis.

A large factor discussed in the success of students is class size. Luckily this data was readily available and required no substitute. This data came from the New York State School Report Card.

Another factor is the spending per student. This would, ideally, be the only factor in the model if the perfect allocation for resources stratagem was discovered and long-term expenditures were separated from short term. Sadly, this is not the case. The issues created from this will be elaborated on in the next section. The first of the data is the

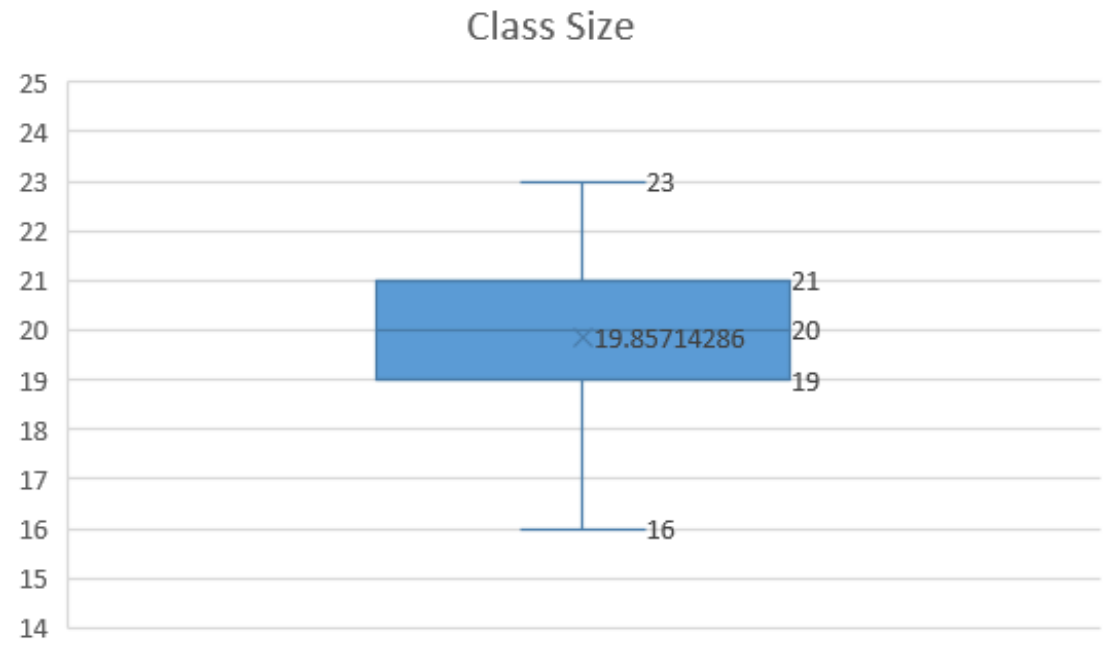
spending per school district in New York State. This was obtained from the Bureau of Economic Analysis. From here a list of districts in each county was utilized to convert the data from district to county. Finally, the spending per county was divided by the students per county, the data for which came from the New York State School Report Card, to get the spending per student.

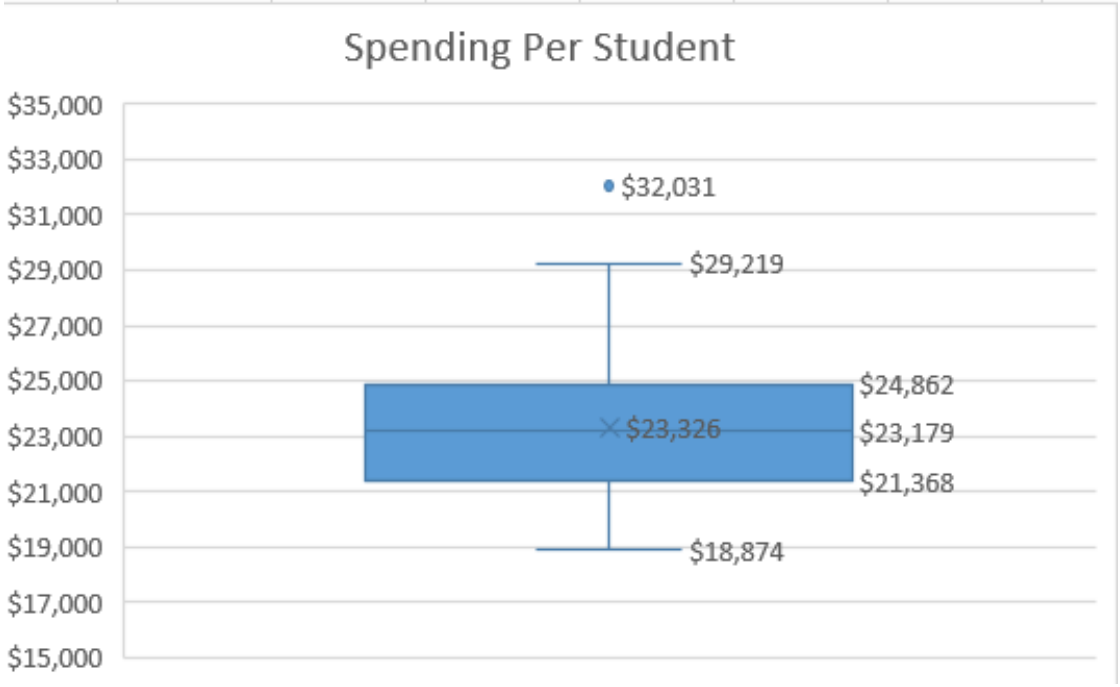
A last control put into place was to avoid a State specific issue. In New York five Counties are significantly bigger than others. In addition, New York City represents a significantly different area than the rest of the State due to its high concentration of people, high costs of living, and other factors. Due to this, these five large Counties were separated from the other Counties to see if they had a significantly different method of utilizing resources to educate children. In addition, the Counties in the New York City region were excluded from the model because the large differences would create the need for additional variables to account for them. Researching what these variables could be and comparing the New York City Counties to the other Counties would be a great opportunity for further research. This research would make the model significantly more versatile, which would reduce the necessity of aggregation to limit the effect of these factors. This reduction in the necessity to separate these counties would allow for the study of individual school districts in a State.

Problems with Data

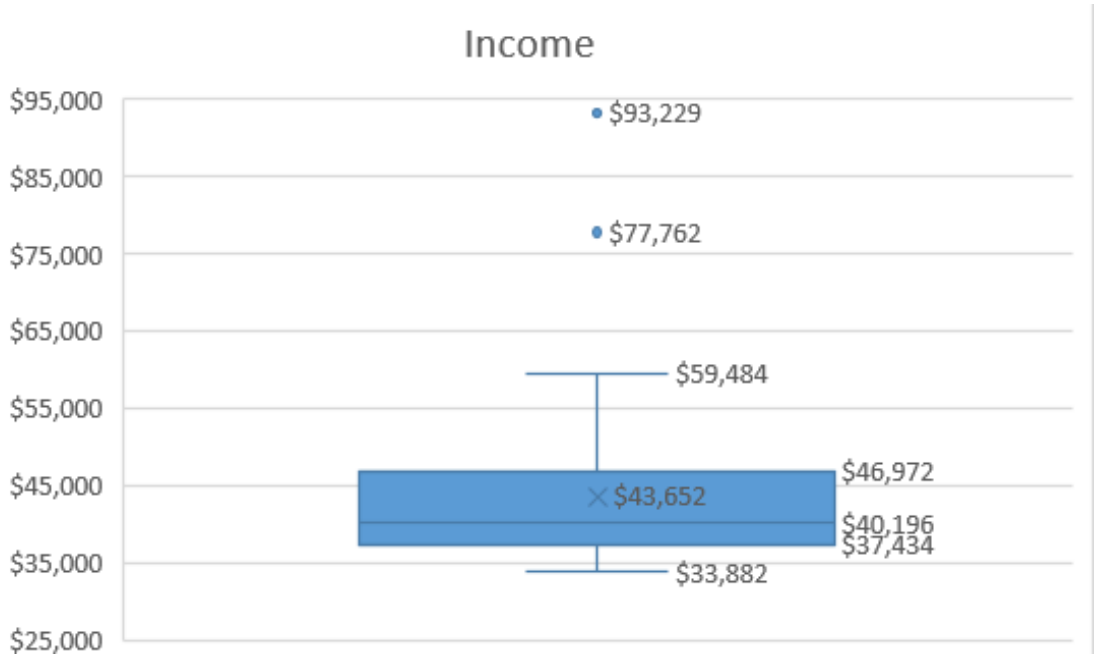
The main weakness with the data across the board is that all the variables have narrow ranges. This is caused by three factors: the separation of counties that are unlike the others, the focus on an individual State, and the aggregation of considering counties instead of school districts or individual schools. That said, with the current amount of research done and information available, these controls were necessary to limit the effect of variables outside of the model. Through the usage of these limiting factors it becomes easier to focus on the differences.

This strong homogeneity is most apparent in spending per student and class size. Class size is centered just under twenty students per teacher, with half of the distribution between nineteen and twenty-one, and only goes as high as twenty-three and as low as sixteen students per teacher. Spending per student shares a similar small range. It is centered just over twenty-three thousand dollars per student and has over half of the data between twenty-one and twenty-five thousand. Both variables have a slight skew as well, but nothing major. Spending per student also has an outlier with Sullivan County spending just over thirty-two thousand per student.

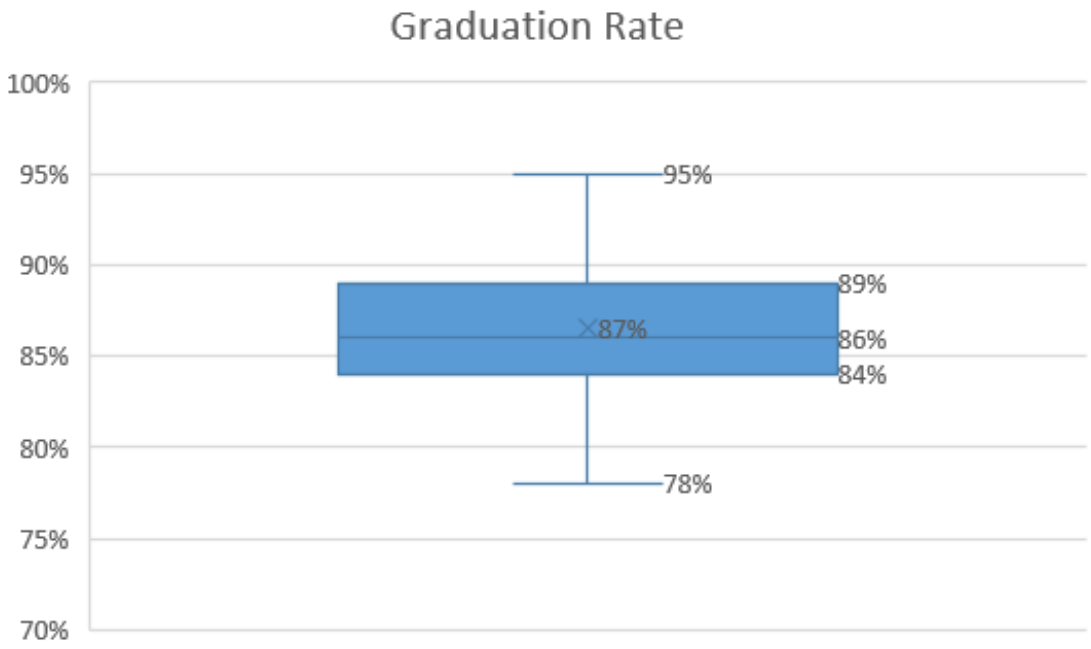

Class Size
25
24
23
22
21
20
19
18
17
16
15
14
23
21
19.85714286
20
19
16


Spending Per Student
$35,000
$33,000
$31,000
$29,000
$27,000
$25,000
$23,000
$21,000
$19,000
$17,000
$15,000
$32,031
$29,219
$24,862
$23,326
$23,179
$21,368
$18,874

County income presents a different issue than class size and spending per student. It is skewed right. This causes half of the data to be in between thirty-three thousand eight hundred eighty-two and forty thousand nine hundred and seventy-two while the rest goes all the way to ninety-three thousand two hundred and twenty-nine. This effect could be potentially mitigated by removing the two outliers from the data set. Doing so would bring the upper range down to fifty-nine thousand four hundred eighty-four. This skewedness can potentially negatively affect the accuracy of statistical tests. A larger sample size would reduce the effect the outliers have, but this would not necessarily remove the skewedness. To account for this skewedness a study as to why income is skewed could be useful. An alternative method of solving this issue would be to find a better measurable variable to represent the effects parents have on education. As this is not the best stand-in the latter would likely yield a better solution. That said, it would require a large amount of work to collect the data on a variable tailored to represent this issue. In addition, income may remain a factor in the equation even with the new variable as it may allow a family to put their children in a better school or hire tutors for struggling children. In this case there may be multicollinearity between this new variable and income. As this is a complicated issue with no easy solution, this thesis will focus on income rather than look for an alternative variable.



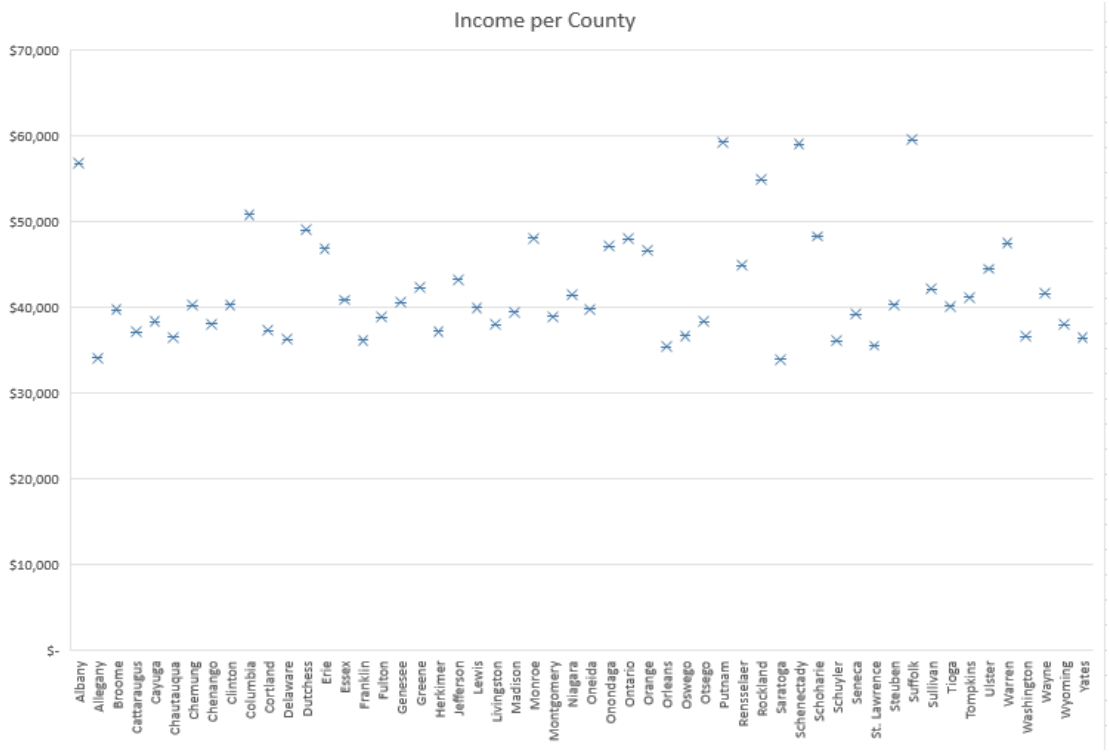
One issue that came up in the data collection is a lack of information on Hamilton County. This led to Hamilton being excluded from the study. It is difficult to speculate in what ways Hamilton's inclusion would have affected the outcomes; however, the affect would likely be greatly reduced by the three controls. That said, there is no strong theoretical rationale for the exclusion of Hamilton, but its exclusion remains an unavoidable issue due to the missing data.



Finally, there is the graduation rate itself. This data showed a relatively even spread in general. There is a slightly higher concentration on the lower half of the mean, but nowhere near enough to consider the data strongly skewed. This likely due to two factors. Firstly, aggregation reduces the extremes in the data by averaging out the best and worst schools in a county with all the others. Secondly, schools that perform too poorly will cause public outcry and cause changes to be made to the worst schools. This would effectively limit the amount of low graduation outliers significantly and push the data away from the skew.

Overall the data is far from perfect; however, most of the flaws in it are due to small sample size and aggregation. Improving the model to the point that it could utilize school districts instead of counties could solve both issues. That said, it would not remove the skew from income.

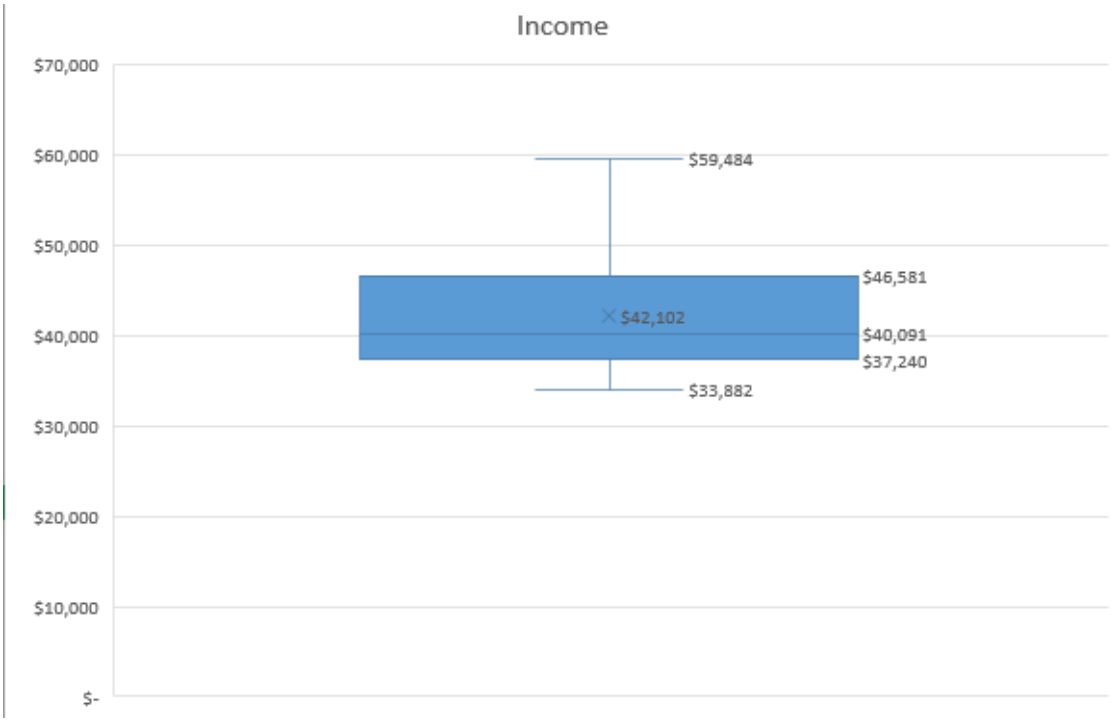
Removal of Outliers

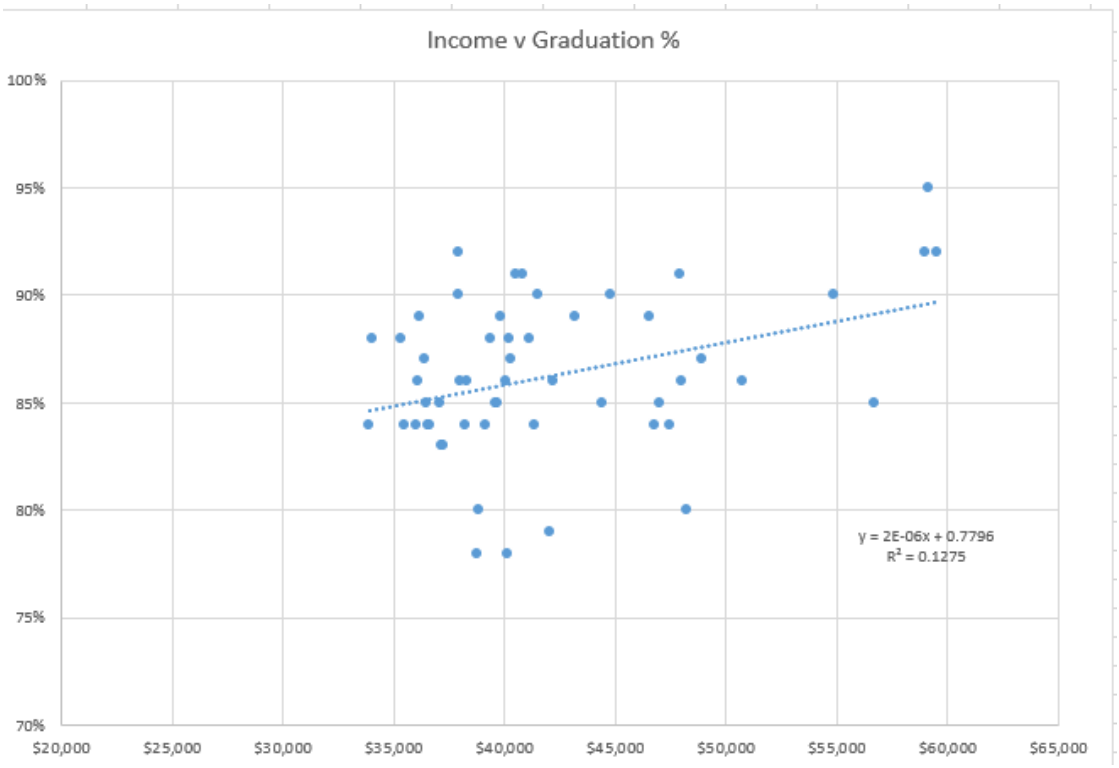


The outliers on County income mentioned in the previous section are Nassau and Westchester. These counties have an average income of $77,762 and $93,229 respectively, while the third highest was $59,484. There are two possible reasons for this great difference from the other counties in income. The first is that there was a miscalculation or a bad data point that provided an incorrect number. In this case the points would need to be ignored as the data would be incorrect. The other explanation is that there is something different about these two counties that drastically affects their level of income. In this case the reason for the discrepancy would need to be identified and future studies will need to identify the reason. The reason could potentially be a factor that could affect educational spending or achievement. Therefore, the data points would need to be omitted in this study as the factor responsible for the difference is controlled for in the other points and not understood.

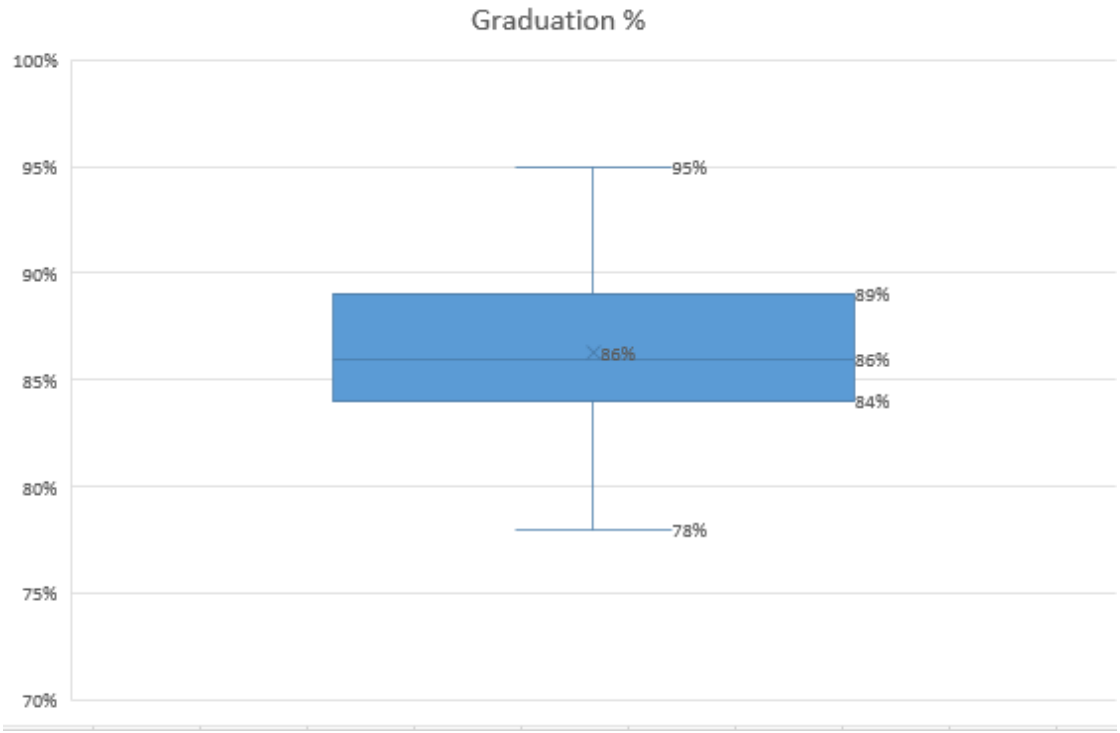
As both possible rationales for the outliers provide the same solution, which is omission, it is not critical to know which of the two is the cause. As future research narrows the scope to smaller segments of the population these outliers will be fixed in one of two ways. If the issue is inaccurate data causing the outliers, then when new data is collected for the more focused study the issue will be resolved. If the outliers are caused for a reason, then looking at a more focused data set will help in identifying the reason for the differences. In either case the move away from over reliance on aggregation will allow future studies to account for the outliers in income.

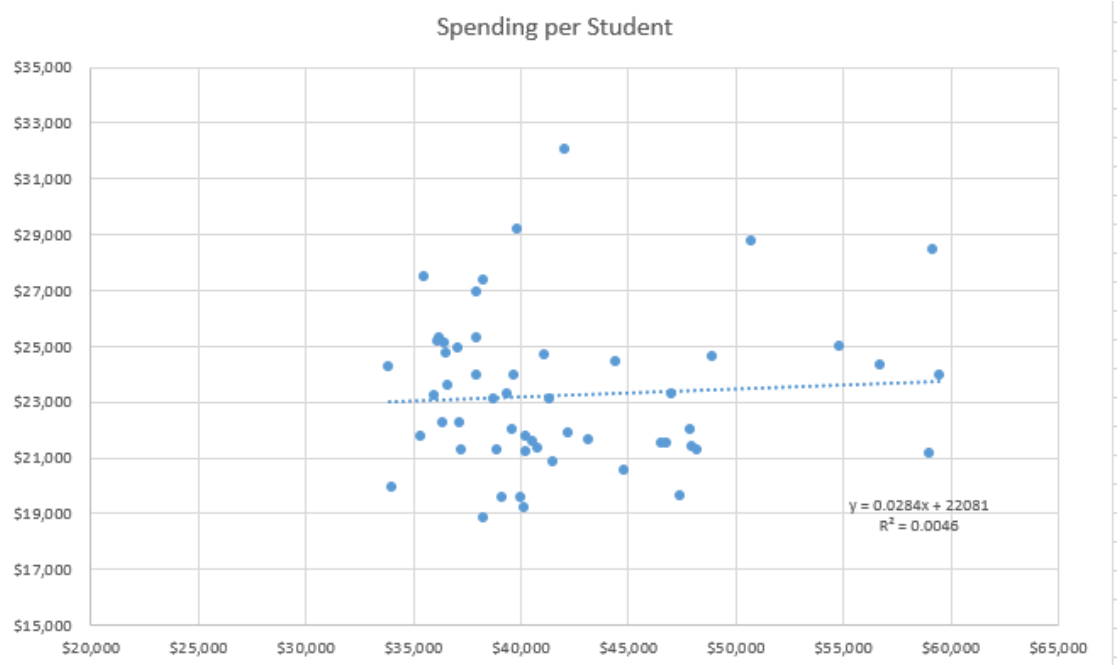
With the long-term solution to the income outlier issue proposed and the short-term solution the same regardless of the reason for the outliers, they will be removed from the data set. This triggers the need to reinterpret the data to ensure that there are no other outliers and see the effect removing them had on the data.





The effect on income is very predictable. The box and whisker plot remain the same except for the removal of the outliers. While the removal of the outliers weakens the effect the skewedness of the data it remains. This shows that there is still merit to understanding the rationale behind why income is skewed if it is to remain a variable in future studies. If another substitute is chosen for parental involvement in education this issue could be circumvented. Overall, income remains an imperfect substitute; however, controlling for the outliers has made it more reliable. With the effects of the outliers understood for income we must now look at the effects it had on the other variables.





Interestingly, graduation rate does not appear to be very effected by the removal of the high-income counties from the data. On the surface this would contradict the

hypothesized positive relationship between income and graduation rate. There are three possible explanations for this contradiction.

First, if the high incomes were caused by an error in data collection there may not be a contradiction to begin with. As none of the other data showed outliers this is a strong possibility.

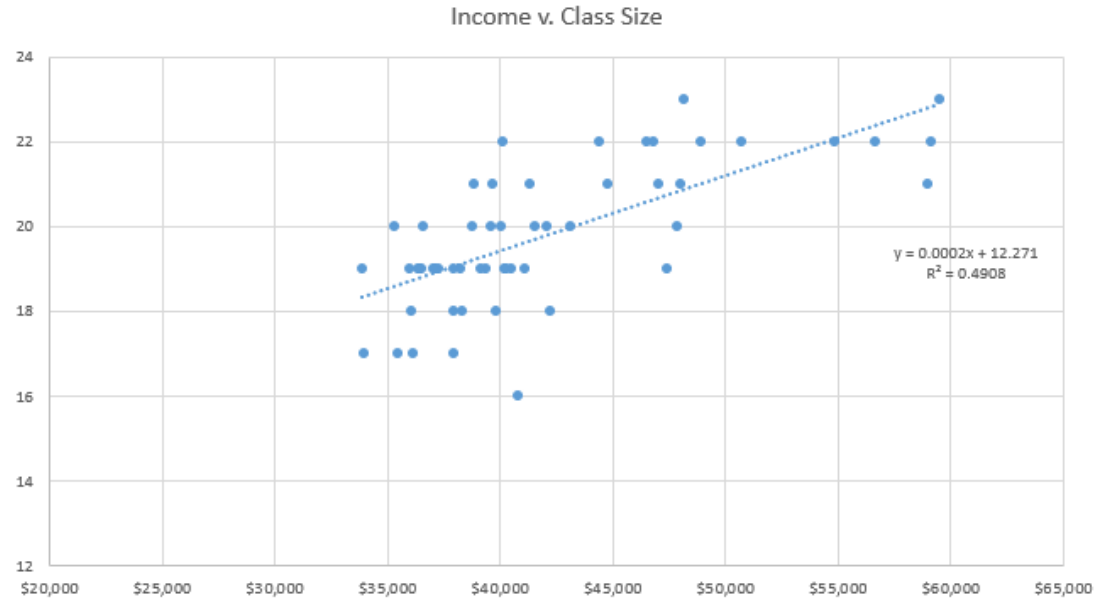
Another explanation could be that very high-income households are subject to other factors that would reduce the quality of income as a substitute variable. One of the more obvious potential issues of this would be if high-income households that valued education highly put their children into private schools while those that did not had their children go to public schools. In this scenario a bias would form in the data in the opposite direction of the trend since the students of wealthy parents who cared about education would be removed from the data set while the children of wealth parents who did not care about education would be left in the data set. While this hypothesized issue oversimplifies the issue and only represents one of the plethora of variables that could be affected, it does show that high income areas could be outliers. Only through understanding the implications of higher income on these factors could the outliers be added back in if this is the cause.

A final explanation is that there could be factors that limit the effect income can have. Some possible explanations for this could be time for kids or government regulations. In the time for kids example the limiting resource would be time that parents could afford to spend teaching their children. This makes sense to a degree because if parents have enough understanding of various subjects to teach their children and the

drive to do so then the bottle neck in the process becomes time that parents can and or willing to spend on the task. All the knowledge in the world would not help in education if you cannot spend any time to impart it. This example shows one possible extreme that could theoretically happen but is not a realistic scenario. That said outliers represent the extremes of what is realistic, and this is one of many potential extreme scenarios. A more realistic extreme would be if the government set limits on what a school should spend on education. In this scenario the parents may be willing to spend more for their children's education and the county may have the money to do so, but the cap is already met causing this not to be spent. In practice this could create a market for the private sector, but setting that aside, it would also cause average income over a certain level to have significantly reduced returns to education.

The last example would also explain why income's effect on a county's spending per student is so small. Additional factors beyond government intervention that could cause this forced homogeneity are if society expects things such as class size or the level of construction on the school building to fall within certain norms or if a popular study calculated ideal rates for spending in different areas that policy makers seek to follow. This line of logic also supports the closeness of class sizes seen in these counties.


Class Size
24
22
20
18
16
14
12
23
21
19.77777778
19.5
19
16


Income v. Class Size
24
22
20
18
16
14
12
$20,000
$25,000
$30,000
$35,000
$40,000
$45,000
$50,000
$55,000
$60,000
$65,000
y = 0.0002x + 12.271
R² = 0.4908

Finally, there is the effect of income on class size. This shows a surprising positive correlation with higher income counties having larger class sizes on average. This is the opposite of what would normally be expected, as a higher income would generally increase the taxes in an area and allow for more teachers to be hired and a smaller class size. That said, there are many factors that could cause this to happen.

The first of these factors are that teachers have incomes as well. If a teacher's income follows the incomes of others in the area, then the higher average income would be negated by this. On the other hand, other inputs to education such as newer equipment would not be as affected by this. Together these factors would decrease productivity of money spent on additional teachers and increase the productivity of technology in higher income areas. This issue could potentially be magnified if new technologies allowed teachers to teach to significantly larger classes as this would cause higher skill level to become significantly more important than the quantity of teachers. Together these effects would promote fewer and more highly paid teachers. Additionally, the limits of technology to effectively overcome these limits would explain why the growth in class size appears to slow as income increases. This can be seen by very few of the higher income counties having more than twenty-two students per teacher.

Setting up the Model

In the simplest of terms, it appears that education (whether it be degree, certification, or general knowledge) can be measured by:

$$E = \alpha S + \beta L + \gamma H .$$

Wherein S is the short-term spending, L is the long-term spending, and H is the investment into education (be it in time or money) by agents working outside the system (such as parents), while alpha, beta, and gamma simply represent the effectiveness of each. This simple model might be effective in comparing similar systems, but to have more useful results it becomes necessary to find out where each school's alpha, beta, and gamma come from. The variables that effect the values of these coefficients can be seen in things such as class size in the short term, retention of skilled teachers, improved equipment in the long term, and how educated the parent is on the outside of school end. That said there are countless other factors beyond those mentioned that could affect the coefficients as well. Sadly, the data available to test this theory leaves much to be desired. To try to counteract these factors a relatively homogeneous group was required. This group was created by looking at counties within the state of New York instead of schools or districts and utilizing the aggregation involved in doing so. To remove the largest of the differences the counties in New York City were removed and the largest counties remaining were separated.

The largest difficulty with the data comes in the separation between short term and long-term spending. Spending in general was difficult to get information on. At first it looked like property taxes would have to be used to approximate the funding for each school; however, with some effort the data for spending per district was available. This

allowed the calculation of spending per county and spending per student per county. To account for the education of the parents one option was to look at the education level of each county, but this would neglect the education they obtained outside of schools during the duration of their lives. To account for this on the job learning income was used as an approximation of gamma since theory shows that income is related to education level. Unfortunately, there is no way to really measure the amount of effort parents spend on teaching their children. Due to this, aggregation is required to level out the effects of parents who value education highly and lowly.

A final issue is how to measure increases in education. This created questions such as are some subjects more important than others? Do grades in lower grades matter, or is the result all that matters? And are there diminishing returns as grades move further away from the minimum needed to pass? To keep the measure of education as simple as possible, the six-year graduation rate for high school was chosen. Effectively this measure is only concerned in if the child could obtain a high school diploma, while ignoring that it took some two extra years and the achievements of students above and beyond simply passing. That said, this is a good measure because many employers value high school diplomas and they (or a GED) are required to continue education. Finally, to see if separating factors determining alpha and beta would help the model class size was included. Including more would have been ideal, but data on many of these factors is difficult to obtain and would require imperfect substitutes. As class size is easily obtainable, in the theories as an important variable, and does not require any substitutes; it serves as a perfect starting point to see if significant gains could be made in optimizing these factors.

With all of this in mind the model becomes:

$$G = \phi C + \lambda M + \tau I + \varepsilon .$$

Wherein G is the six-year graduation rate, C is class size, M is money spent per student, I is income, and epsilon is the error term, while phi, lambda, and tau are coefficients used to find the power of each. Class size is expected to be negatively correlated with graduation because it is one of the factors that determines alpha in the simplified equation and theory says that reducing class size should increase education. Likewise, income is expected to be positively correlated because it is a substitute for gamma in the simplified equation. Money spent per student on the other hand is difficult to predict. On one hand spending more should help the students, so it should be positively correlated; however, it is a very poor estimator because it does not separate the long-term spending (for example facility improvement) from the short term (for example teacher salaries or learning materials) or differentiate between what different schools are using the money on. Not differentiating between what schools spend the money on is a huge issue as different schools could have drastically different opportunities to increase their education levels with each unit of money. Due to these issues, it is doubtful that money spent per student will be statistically significant. For these reasons, the model will be run twice: once including money spent per student and once not including it.

Econometrics

Looking at the T values it quickly becomes apparent that spending per student (.02) was not statistically significant. This is a disappointing result, but it is expected because the substitute was a poor measure to use in the first place; however, hope remains to fix it. Class size had a T score of -3.05, which is both significant and negatively correlated as expected. This shows that splitting up spending into the different things it is used on is a viable method of finding the effects of long term and short term educational spending. That said, this will make the formula significantly more complicated. Because of this increased complication, doing so on a large scale would require a huge amount of data.

Finally, income has shown to be a good approximation for gamma with a T score of 5.02 showing a strong positive correlation as theorized. Unfortunately, this data point is not as useful as it seems in the small scale, as it requires the extremes of parental effort to be removed with aggregation. This becomes a major issue as the effects of short term and long term educational spending are much easier to get data for in the small scale. To remain as useful a measure would take either enough data to keep the scale relatively large or finding out a way to measure the effort forces outside of school put forth to help children learn.

Results

The SAS System

The REG Procedure
Model: MODEL1
Dependent Variable: GRADPCT GRADPCT

Number of Observations Read	54
Number of Observations Used	54

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	4	0.02896	0.00724	8.71	<.0001
Error	49	0.04073	0.00083116		
Corrected Total	53	0.06968			

Root MSE	0.02883	R-Square	0.4155
Dependent Mean	0.86278	Adj R-Sq	0.3678
Coeff Var	3.34151		

Parameter Estimates

Variable	Label	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|	Heteroscedasticity Consistent			Variance Inflation
							Standard Error	t Value	Pr > |t|	
Intercept	Intercept	1	0.97124	0.06198	15.67	<.0001	0.06892	14.51	<.0001	0
Income	Income	1	0.00000495	8.638922E-7	5.74	<.0001	8.996102E-7	5.51	<.0001	2.04236
Big	Big	1	-0.02102	0.01424	-1.48	0.1464	0.00973	-2.16	0.0357	1.10684
Csize	Csize	1	-0.01517	0.00338	-4.48	<.0001	0.00357	-4.25	<.0001	2.02923
SPS	SPS	1	-6.47359E-7	0.00000147	-0.44	0.6607	0.00000198	-0.33	0.7448	1.03558

The purpose of running the first test was to get a general idea of the strength of each variable. In doing so, the hypotheses on the expected signs and significance of the variables can be either proven or disproven. To do this the T value of each variable will be compared to the standard confidence level of two.

The variable with the highest T value was income, with a score of 5.74. This score is larger than two, making income significant. Additionally, it shows a positive

value as predicted. Together these two factors show that in similar counties those with higher levels of income will tend to have higher six-year high school graduation rates. This similar county constraint is especially important in this initial test because of the inclusion of the other variables. This constraint will be loosened in a later section by looking at income by itself, however, doing so will not remove this constraint as the counties examined were filtered to make them similar (only looking at counties in New York State, excluding the counties of New York City, and the removal of outliers.)

The next highest T score is class size, with a value of -4.48. This is a significant variable as the absolute value of -4.48 is larger than two. The negative sign implies that as class sizes grow larger the six-year high school graduation rate in a county will fall compared to similar counties. This matches the hypothesized sign for class size. Like income, the constraints on class size will be loosened to test if it will remain significant without them. Additionally, income and class size will be run together in a future section. Doing so will allow a closer look at the effects seen in the scatter plot of the previous section.

The last quantitative variable measured was spending per student. This variable had a t score of -0.44. This is below the standard cut-off of two making it not significant. This was expected as the quality of the substitution of spending per student for both the long term and short-term components of money spent on education was low. As this substitution was inadequate, future studies should try other substitutes and a test will be done without spending per student as a variable. A study that focuses on a micro scale could potentially find a better substitute by looking at school districts that have information on where they spent their money each year. From there the costs could be

separated into short-term and long term. The main issue with this would be the difficulties in obtaining a large data set. A potential macro approach to this would be looking at the spending per students over many years and removing the outliers. These outliers would likely be years that significant money was spent on long term assets such as computer lab upgrades or renovations. Doing this would allow a portion of long term spending to be separated out from the short term and calculated separately (by subtracting the mean of the others from each); however, it would under represent long term spending as it would ignore smaller purchases and the potential for schools to reduce short term spending some years to purchase long term assets and the money consistently budgeted toward long term assets.

The last variable looked at was if the counties were in the big five. This had a T score of -1.48. As this is somewhat close to the significance of the cut-off point of two, a test will be run without the insignificant variable of spending per student to ensure that this variable is truly not significant.

The SAS System

The REG Procedure
Model: MODEL1
Dependent Variable: GRADPCT GRADPCT

Number of Observations Read	54
Number of Observations Used	54

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	0.02879	0.00960	11.74	<.0001
Error	50	0.04089	0.00081778		
Corrected Total	53	0.06968			

Root MSE	0.02860	R-Square	0.4132
Dependent Mean	0.86278	Adj R-Sq	0.3780
Coeff Var	3.31450		

Parameter Estimates

Variable	Label	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|	Heteroscedasticity Consistent			Variance Inflation
							Standard Error	t Value	Pr > |t|	
Intercept	Intercept	1	0.95479	0.04912	19.44	<.0001	0.04515	21.15	<.0001	0
Income	Income	1	0.00000489	8.459074E-7	5.79	<.0001	8.453996E-7	5.79	<.0001	1.99025
Big	Big	1	-0.02041	0.01406	-1.45	0.1529	0.00955	-2.14	0.0375	1.09646
Csize	Csize	1	-0.01497	0.00333	-4.50	<.0001	0.00345	-4.34	<.0001	1.99394

This second run of the test removes the statistically insignificant spending per student from the equation. From this the Adjusted R squared rose from .3678 to .3780 and the T values of income and class size rose from 5.74 to 5.79 and -4.48 to -4.5 respectively. Last, the T score of the qualitative variable that separates out the big counties fell from -1.48 to -1.45. As this is below the absolute value of two this qualitative variable is not significant. This shows that the big counties do not behave significantly differently from the other counties outside of New York City Counties in New York State. Due to this, Big will be removed from the other variables in a final test. This shows that the strictness of controls to get a data set with minimal outside factors

can be reduced to an extent. A potential way future studies could do this would be to remove big counties as a variable and add the counties of New York City as an additional qualitative variable. If the counties of New York City also showed no significant difference, a study could attempt to look at multiple states.

The SAS System

The REG Procedure
Model: MODEL3
Dependent Variable: GRADPCT GRADPCT

Number of Observations Read	54
Number of Observations Used	54

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	0.02707	0.01354	16.20	<.0001
Error	51	0.04261	0.00083553		
Corrected Total	53	0.06968			

Root MSE	0.02891	R-Square	0.3885
Dependent Mean	0.86278	Adj R-Sq	0.3645
Coeff Var	3.35029		

Parameter Estimates

Variable	Label	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|	Heteroscedasticity Consistent			Variance Inflation
							Standard Error	t Value	Pr > |t|	
Intercept	Intercept	1	0.97063	0.04841	20.05	<.0001	0.04326	22.44	<.0001	0
Income	Income	1	0.00000475	8.493195E-7	5.60	<.0001	9.010184E-7	5.27	<.0001	1.96371
Csize	Csize	1	-0.01557	0.00334	-4.67	<.0001	0.00330	-4.72	<.0001	1.96371

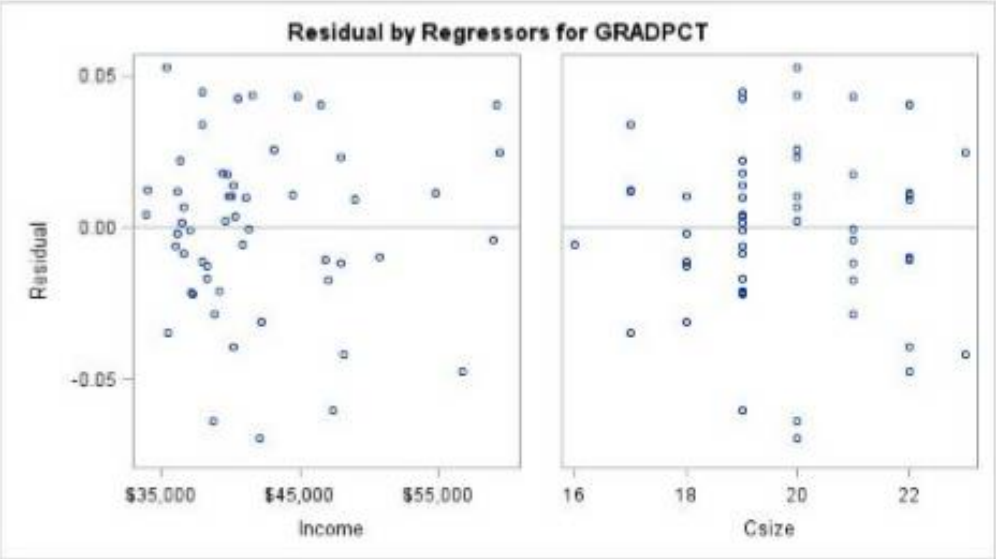
The SAS System

The REG Procedure
Model: MODEL3
Dependent Variable: GRADPCT GRADPCT

Durbin-Watson D	1.811
Number of Observations	54
1st Order Autocorrelation	0.082

In this regression it is clear that every variable is significant. Income has a T-value of 5.6, while class size has a value of -4.67. There was a slight decrease in the Adjusted R squared from .378 to .3645. This is because, while it did not meet the significance cutoff of a T-value of 2, the qualitative indicator Big still had a relatively strong effect on the data. This shows that while it was not crucial to use in this test, such qualitative variables seperating heterogenous sections of data may be needed in future tests. This points to at least one important variable missing from or poorly substituted in this model. One potential example of this is the removed variable spending per student. While theory showed this to be an important variable the data available was insufficient to properly utilize it here as discussed above. Given the issues in finding substitute variables the adjusted R squared of 0.3645 is surprisingly high. These results are encouraging, but it is too early to say that it proves anything. The Durban Watson statistic for this data is also encouraging. Its value of 1.811 is relatively close to 2. This shows a low amount of autocorrelation; however, as this is a cross sectional study this is to be expected. The variance inflation factor does not look quite as promising. With a value of 1.96371 it shows evidence of a moderate amount of multicollinearity. To

determine the strength of this adjusted R squared and the effects of the multicollinearity the parts making it up must be analyzed.



Overall, the residual plots look acceptable. Both income and class size appear relatively random and centered near zero. That said, they are not perfect. Income shows evidence of skewedness. This confirms the analysis on the previous section. On the other hand, class size shows clear striations. This is due to the data rounding to the nearest integral. This rounding makes some sense as fractional parts of students do not exist.

The SAS System

The REG Procedure
Model: MODEL6
Dependent Variable: GRADPCT GRADPCT

Number of Observations Read	54
Number of Observations Used	54

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	0.00091252	0.00091252	0.69	0.4100
Error	52	0.06877	0.00132		
Corrected Total	53	0.06968			

Root MSE	0.03637	R-Square	0.0131
Dependent Mean	0.86278	Adj R-Sq	-0.0059
Coeff Var	4.21504		

Parameter Estimates

Variable	Label	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|	Heteroscedasticity Consistent			Variance Inflation
							Standard Error	t Value	Pr > |t|	
Intercept	Intercept	1	0.91200	0.05946	15.34	<.0001	0.06374	14.31	<.0001	0
Csize	Csize	1	-0.00249	0.00300	-0.83	0.4100	0.00332	-0.75	0.4564	1.00000

Upon looking at class size on its own, the effects of the multicollinearity become clear. The T-value has plummeted from -4.67 to -.83. This reduction in the absolute T- value makes class size no longer significant. Theoretically this makes sense. The reason for this is class size was chosen as one factor that shows the efficiency of the utilization of the resources the schools have. Comparing efficiencies and looking at results will not show useful data if the resources available to each section are not held near constant. For instance, if you were to look at an example of two engines wherein the first has perfect utilization of fuel while the other has an efficiency of only 50%, if the less efficient engine was provided twice the fuel, the two engines would yield the same result. Interestingly, this multicollinearity was more expected to be seen from class size and

spending per student. This effect existing with income confirms the suspicion that income would include a large amount of either the short term, long term spending per student or both. This confirms income status as an improper substitute for parental involvement in education as it also contains a large amount of the spending effect. This would indicate a high level of multicollinearity between income and spending per student. This will cause any study using income as a variable to have potentially misleading results.

The SAS System

The REG Procedure
Model: MODEL4
Dependent Variable: GRADPCT GRADPCT

Number of Observations Read	54
Number of Observations Used	54

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	0.00888	0.00888	7.60	0.0080
Error	52	0.06080	0.00117		
Corrected Total	53	0.06968			

Root MSE	0.03419	R-Square	0.1275
Dependent Mean	0.86278	Adj R-Sq	0.1107
Coeff Var	3.96322		

Parameter Estimates

Variable	Label	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|	Heteroscedasticity Consistent			Variance Inflation
							Standard Error	t Value	Pr > |t|	
Intercept	Intercept	1	0.77957	0.03054	25.52	<.0001	0.02860	27.25	<.0001	0
Income	Income	1	0.00000198	7.169668E-7	2.76	0.0080	6.822886E-7	2.90	0.0055	1.00000

The effects of the multicollinearity on income are less severe than those on class size. While the T- value had a reduction from 5.6 to 2.76, income remains significant. Unfortunately, for reasons discussed above, it should most likely be replaced as a variable in future studies if possible despite this significance.

Conclusion

Overall, the statistical analysis of the data gave little usable information when it comes to improving educational systems. That said it was not without merit. Through analyzing the thought processes behind this result from the reverse usable value can be gleaned.

The most obvious of these is the net results. The findings showing improper substitutes will, hopefully, lead to future studies avoiding these substitutes. Moving to the next level, by understanding the rationales behind why these are poor substitutes similar poor substitutes can be avoided. This is bolstered by the addition of the theoretical research which points towards the reasons the substitutes were initially chosen and by the self-reflection in speculating possible substitutes. Together these factors will help future studies avoid these pitfalls and potentially point them towards substitutes that can work.

A less binary takeaway from this study can be seen in the creation of the theoretical formula. In this some will agree with the formula created and some will disagree, but it will spark possibilities for solutions in the minds of those who contemplate it. This contemplation exponentially increases when the review of literature is added to the equation. Through looking at the research contained herein, not only is the thought process behind the theoretical model revealed, but it also exposes the reader to ideas from previous studies. This may spark the reader to investigate ways to use these ideas in a completely different method than used within this paper. While the results of this study are not practically usable, much of the effort put into creating them is.

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Appendix

Full Data

County	Income	Csize	Students	GRAD PCT	SPS	Big
Albany	$56,692	22	994	85%	$24,310	1
Allegany	$34,004	17	238	88%	$19,923	0
Broome	$39,634	20	728	85%	$22,020	1
Cattaraugus	$37,080	19	434	85%	$24,908	0
Cayuga	$38,257	19	308	84%	$18,874	0
Chautauqua	$36,454	19	700	85%	$25,087	0
Chemung	$40,149	22	308	78%	$19,234	0
Chenango	$37,980	18	308	86%	$25,298	0
Clinton	$40,253	19	378	87%	$21,748	0
Columbia	$50,741	22	266	86%	$28,770	0
Cortland	$37,265	19	238	83%	$21,310	0
Delaware	$36,177	17	280	89%	$25,300	0
Dutchess	$48,921	22	1036	87%	$24,603	0
Erie	$46,786	22	2926	84%	$21,540	1
Essex	$40,810	16	210	91%	$21,360	0
Franklin	$36,113	18	280	86%	$25,185	0
Fulton	$38,760	20	308	78%	$23,077	0
Genesee	$40,532	19	266	91%	$21,614	0
Greene	$42,203	18	224	86%	$21,884	0
Hamilton	$51,895	8	70	93%	$29,470	0
Herkimer	$37,163	19	336	83%	$22,234	0
Jefferson	$43,170	20	532	89%	$21,649	0
Lewis	$39,857	18	182	89%	$29,219	0
Livingston	$37,955	19	294	90%	$26,911	0
Madison	$39,352	19	364	88%	$23,263	0
Monroe	$47,986	21	2506	86%	$21,391	1
Montgomery	$38,872	21	196	80%	$21,250	0
Nassau	$77,762	22	4326	94%	$23,818	0
Niagara	$41,355	21	700	84%	$23,132	0
Oneida	$39,684	21	1008	85%	$23,986	0
Onondaga	$47,034	21	1680	85%	$23,299	1
Ontario	$47,900	20	420	91%	$22,017	0
Orange	$46,513	22	1092	89%	$21,513	0
Orleans	$35,324	20	168	88%	$21,788	0
Oswego	$36,593	20	546	84%	$23,568	0
Otsego	$38,293	18	308	86%	$27,375	0
Putnam	$59,160	22	294	95%	$28,448	0

Rensselaer	$44,823	21	546	90%	$20,565	0
Rockland	$54,838	22	882	90%	$25,000	0
Saratoga	$33,882	19	518	84%	$24,273	0
Schenectady	$58,979	21	658	92%	$21,183	0
Schoharie	$48,206	23	602	80%	$21,266	0
Schuyler	$35,998	19	154	84%	$23,227	0
Seneca	$39,124	19	70	84%	$19,592	0
St. Lawrence	$35,472	17	154	84%	$27,505	0
Steuben	$40,243	19	504	88%	$21,218	0
Suffolk	$59,484	23	4732	92%	$23,972	0
Sullivan	$42,053	20	252	79%	$32,031	0
Tioga	$40,033	20	266	86%	$19,561	0
Tompkins	$41,095	19	420	88%	$24,696	0
Ulster	$44,422	22	616	85%	$24,448	0
Warren	$47,429	19	266	84%	$19,628	0
Washington	$36,563	19	336	84%	$24,726	0
Wayne	$41,524	20	518	90%	$20,836	0
Westchester	$93,229	22	3514	91%	$25,391	0
Wyoming	$37,941	17	154	92%	$23,937	0
Yates	$36,371	19	70	87%	$22,282	0

Data without Hamilton

County	Income	Csize	Students	GRAD PCT	SPS	Big
Albany	$56,692	22	994	85%	$24,310	1
Allegany	$34,004	17	238	88%	$19,923	0
Broome	$39,634	20	728	85%	$22,020	1
Cattaraugus	$37,080	19	434	85%	$24,908	0
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Clinton	$40,253	19	378	87%	$21,748	0
Columbia	$50,741	22	266	86%	$28,770	0
Cortland	$37,265	19	238	83%	$21,310	0
Delaware	$36,177	17	280	89%	$25,300	0
Dutchess	$48,921	22	1036	87%	$24,603	0
Erie	$46,786	22	2926	84%	$21,540	1
Essex	$40,810	16	210	91%	$21,360	0

Franklin	$36,113	18	280	86%	$25,185	0
Fulton	$38,760	20	308	78%	$23,077	0
Genesee	$40,532	19	266	91%	$21,614	0
Greene	$42,203	18	224	86%	$21,884	0
Herkimer	$37,163	19	336	83%	$22,234	0
Jefferson	$43,170	20	532	89%	$21,649	0
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Westchester	$93,229	22	3514	91%	$25,391	0
Wyoming	$37,941	17	154	92%	$23,937	0
Yates	$36,371	19	70	87%	$22,282	0

Data without Outliers

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Albany	$56,692	22	994	85%	$24,310	1
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Oneida	$39,684	21	1008	85%	$23,986	0
Onondaga	$47,034	21	1680	85%	$23,299	1
Ontario	$47,900	20	420	91%	$22,017	0
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Wayne	$41,524	20	518	90%	$20,836	0
Wyoming	$37,941	17	154	92%	$23,937	0
Yates	$36,371	19	70	87%	$22,282	0

Spending per Student

County	Average of Income	Average of Csize	Average of SPS	Average of GRAD PCT
Albany	56692	22	24310.3247	0.85
Allegany	34004	17	19922.6769	0.88
Broome	39634	20	22019.8386	0.85
Cattaraugus	37080	19	24907.93153	0.85
Cayuga	38257	19	18874.42145	0.84
Chautauqua	36454	19	25087.43804	0.85
Chemung	40149	22	19233.64087	0.78
Chenango	37980	18	25297.73853	0.86
Clinton	40253	19	21748.14255	0.87
Columbia	50741	22	28769.84984	0.86
Cortland	37265	19	21309.96435	0.83
Delaware	36177	17	25299.91791	0.89
Dutchess	48921	22	24603.33118	0.87
Erie	46786	22	21540.00916	0.84
Essex	40810	16	21360.30311	0.91
Franklin	36113	18	25185.23703	0.86

Fulton	38760	20	23076.55524	0.78
Genesee	40532	19	21613.92473	0.91
Greene	42203	18	21884.2173	0.86
Herkimer	37163	19	22234.44329	0.83
Jefferson	43170	20	21648.99494	0.89
Lewis	39857	18	29219.0707	0.89
Livingston	37955	19	26910.92672	0.9
Madison	39352	19	23263.39745	0.88
Monroe	47986	21	21390.86991	0.86
Montgomery	38872	21	21250.01027	0.8
Nassau	77762	22	23818.00562	0.94
Niagara	41355	21	23131.90993	0.84
Oneida	39684	21	23985.62548	0.85
Onondaga	47034	21	23298.78799	0.85
Ontario	47900	20	22016.6548	0.91
Orange	46513	22	21512.85586	0.89
Orleans	35324	20	21787.81077	0.88
Oswego	36593	20	23568.35616	0.84
Otsego	38293	18	27375.35331	0.86
Putnam	59160	22	28448.47697	0.95
Rensselaer	44823	21	20565.29294	0.9
Rockland	54838	22	24999.94122	0.9
Saratoga	33882	19	24272.62847	0.84
Schenectady	58979	21	21182.92824	0.92
Schoharie	48206	23	21266.23017	0.8
Schuyler	35998	19	23226.99117	0.84
Seneca	39124	19	19592.36419	0.84
St. Lawrence	35472	17	27505.4282	0.84
Steuben	40243	19	21217.68568	0.88
Suffolk	59484	23	23971.53664	0.92
Sullivan	42053	20	32030.50266	0.79
Tioga	40033	20	19560.90449	0.86
Tompkins	41095	19	24696.46999	0.88
Ulster	44422	22	24448.02369	0.85
Warren	47429	19	19628.21814	0.84
Washington	36563	19	24726.19112	0.84
Wayne	41524	20	20836.13758	0.9
Westchester	93229	22	25390.6633	0.91
Wyoming	37941	17	23936.78941	0.92
Yates	36371	19	22281.6172	0.87
Grand Total	**43651.66071**	**19.85714286**	**23325.77782**	**0.865**

Big v. Small County

County	Average of Income	Average of Csize	Average of SPS	Average of GRAD PCT
0				
Allegany	34004	17	19922.6769	0.88
Cattaraugus	37080	19	24907.93153	0.85
Cayuga	38257	19	18874.42145	0.84
Chautauqua	36454	19	25087.43804	0.85
Chemung	40149	22	19233.64087	0.78
Chenango	37980	18	25297.73853	0.86
Clinton	40253	19	21748.14255	0.87
Columbia	50741	22	28769.84984	0.86
Cortland	37265	19	21309.96435	0.83
Delaware	36177	17	25299.91791	0.89
Dutchess	48921	22	24603.33118	0.87
Essex	40810	16	21360.30311	0.91
Franklin	36113	18	25185.23703	0.86
Fulton	38760	20	23076.55524	0.78
Genesee	40532	19	21613.92473	0.91
Greene	42203	18	21884.2173	0.86
Herkimer	37163	19	22234.44329	0.83
Jefferson	43170	20	21648.99494	0.89
Lewis	39857	18	29219.0707	0.89
Livingston	37955	19	26910.92672	0.9
Madison	39352	19	23263.39745	0.88
Montgomery	38872	21	21250.01027	0.8
Nassau	77762	22	23818.00562	0.94
Niagara	41355	21	23131.90993	0.84
Oneida	39684	21	23985.62548	0.85
Ontario	47900	20	22016.6548	0.91
Orange	46513	22	21512.85586	0.89
Orleans	35324	20	21787.81077	0.88
Oswego	36593	20	23568.35616	0.84
Otsego	38293	18	27375.35331	0.86
Putnam	59160	22	28448.47697	0.95
Rensselaer	44823	21	20565.29294	0.9
Rockland	54838	22	24999.94122	0.9
Saratoga	33882	19	24272.62847	0.84

Schenectady	58979	21	21182.92824	0.92
Schoharie	48206	23	21266.23017	0.8
Schuyler	35998	19	23226.99117	0.84
Seneca	39124	19	19592.36419	0.84
St. Lawrence	35472	17	27505.4282	0.84
Steuben	40243	19	21217.68568	0.88
Suffolk	59484	23	23971.53664	0.92
Sullivan	42053	20	32030.50266	0.79
Tioga	40033	20	19560.90449	0.86
Tompkins	41095	19	24696.46999	0.88
Ulster	44422	22	24448.02369	0.85
Warren	47429	19	19628.21814	0.84
Washington	36563	19	24726.19112	0.84
Wayne	41524	20	20836.13758	0.9
Westchester	93229	22	25390.6633	0.91
Wyoming	37941	17	23936.78941	0.92
Yates	36371	19	22281.6172	0.87
0Total	**43261.98039**	**19.7254902**	**23405.56328**	**0.866470588**
1				
Albany	56692	22	24310.3247	0.85
Broome	39634	20	22019.8386	0.85
Erie	46786	22	21540.00916	0.84
Monroe	47986	21	21390.86991	0.86
Onondaga	47034	21	23298.78799	0.85
1Total	**47626.4**	**21.2**	**22511.96607**	**0.85**
Grand Total	**43651.66071**	**19.85714286**	**23325.77782**	**0.865**

Income per County

County	Average of Income
Albany	56692
Allegany	34004
Broome	39634
Cattaraugus	37080
Cayuga	38257
Chautauqua	36454
Chemung	40149
Chenango	37980
Clinton	40253

Columbia	50741
Cortland	37265
Delaware	36177
Dutchess	48921
Erie	46786
Essex	40810
Franklin	36113
Fulton	38760
Genesee	40532
Greene	42203
Herkimer	37163
Jefferson	43170
Lewis	39857
Livingston	37955
Madison	39352
Monroe	47986
Montgomery	38872
Nassau	77762
Niagara	41355
Oneida	39684
Onondaga	47034
Ontario	47900
Orange	46513
Orleans	35324
Oswego	36593
Otsego	38293
Putnam	59160
Rensselaer	44823
Rockland	54838
Saratoga	33882
Schenectady	58979
Schoharie	48206
Schuyler	35998
Seneca	39124
St. Lawrence	35472
Steuben	40243
Suffolk	59484
Sullivan	42053
Tioga	40033
Tompkins	41095
Ulster	44422

Warren	47429
Washington	36563
Wayne	41524
Westchester	93229
Wyoming	37941
Yates	36371
Grand Total	**43651.66071**

Income v. Class Size

Income	Average of Csize
$33,882	19
$34,004	17
$35,324	20
$35,472	17
$35,998	19
$36,113	18
$36,177	17
$36,371	19
$36,454	19
$36,563	19
$36,593	20
$37,080	19
$37,163	19
$37,265	19
$37,941	17
$37,955	19
$37,980	18
$38,257	19
$38,293	18
$38,760	20
$38,872	21
$39,124	19
$39,352	19
$39,634	20
$39,684	21
$39,857	18
$40,033	20
$40,149	22

$40,243	19
$40,253	19
$40,532	19
$40,810	16
$41,095	19
$41,355	21
$41,524	20
$42,053	20
$42,203	18
$43,170	20
$44,422	22
$44,823	21
$46,513	22
$46,786	22
$47,034	21
$47,429	19
$47,900	20
$47,986	21
$48,206	23
$48,921	22
$50,741	22
$54,838	22
$56,692	22
$58,979	21
$59,160	22
$59,484	23
$77,762	22
$93,229	22
Grand Total	**19.85714286**

Income v. Spending per Student

Income	Average of SPS
$33,882	24272.62847
$34,004	19922.6769
$35,324	21787.81077
$35,472	27505.4282
$35,998	23226.99117
$36,113	25185.23703

$36,177	25299.91791
$36,371	22281.6172
$36,454	25087.43804
$36,563	24726.19112
$36,593	23568.35616
$37,080	24907.93153
$37,163	22234.44329
$37,265	21309.96435
$37,941	23936.78941
$37,955	26910.92672
$37,980	25297.73853
$38,257	18874.42145
$38,293	27375.35331
$38,760	23076.55524
$38,872	21250.01027
$39,124	19592.36419
$39,352	23263.39745
$39,634	22019.8386
$39,684	23985.62548
$39,857	29219.0707
$40,033	19560.90449
$40,149	19233.64087
$40,243	21217.68568
$40,253	21748.14255
$40,532	21613.92473
$40,810	21360.30311
$41,095	24696.46999
$41,355	23131.90993
$41,524	20836.13758
$42,053	32030.50266
$42,203	21884.2173
$43,170	21648.99494
$44,422	24448.02369
$44,823	20565.29294
$46,513	21512.85586
$46,786	21540.00916
$47,034	23298.78799
$47,429	19628.21814
$47,900	22016.6548
$47,986	21390.86991
$48,206	21266.23017

$48,921	24603.33118
$50,741	28769.84984
$54,838	24999.94122
$56,692	24310.3247
$58,979	21182.92824
$59,160	28448.47697
$59,484	23971.53664
$77,762	23818.00562
$93,229	25390.6633
Grand Total	**23325.77782**

Income v. Graduation Percent

Income	Average of GRAD PCT
$33,882	0.84
$34,004	0.88
$35,324	0.88
$35,472	0.84
$35,998	0.84
$36,113	0.86
$36,177	0.89
$36,371	0.87
$36,454	0.85
$36,563	0.84
$36,593	0.84
$37,080	0.85
$37,163	0.83
$37,265	0.83
$37,941	0.92
$37,955	0.9
$37,980	0.86
$38,257	0.84
$38,293	0.86
$38,760	0.78
$38,872	0.8
$39,124	0.84
$39,352	0.88
$39,634	0.85
$39,684	0.85

$39,857	0.89
$40,033	0.86
$40,149	0.78
$40,243	0.88
$40,253	0.87
$40,532	0.91
$40,810	0.91
$41,095	0.88
$41,355	0.84
$41,524	0.9
$42,053	0.79
$42,203	0.86
$43,170	0.89
$44,422	0.85
$44,823	0.9
$46,513	0.89
$46,786	0.84
$47,034	0.85
$47,429	0.84
$47,900	0.91
$47,986	0.86
$48,206	0.8
$48,921	0.87
$50,741	0.86
$54,838	0.9
$56,692	0.85
$58,979	0.92
$59,160	0.95
$59,484	0.92
$77,762	0.94
$93,229	0.91
Grand Total	**0.865**