Original Paper

Which States Support Which Ones?

Predicting Federal Flow Through From the Feds to the States

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Abstract

While politicians in Washington, who have already authorized trillions of funds for businesses in the past 3 years, have been arguing over allocating funds for state and local governments, there have been a number of suggestions that stimulus packages potentially benefit certain states at the expense to others. The arguments primarily appear to come down to politics – "red," Republican-led states versus "blue," Democratically-led states. The insinuation is that that the "blue" states are more poorly run than the red states and that the better run "red" states should not be "bailing out" poorly run "blue" states. A linear regression model was developed that perfectly predicted both federal fund recipients and "red" or "blue" designations. Correlation and principal component analysis was run to determine the factors that were the best predictors. The truth appears to be as Governor Cuomo states, "blue" states are better run, better funded and are more productive than "red" states when measuring gross domestic product, income and net tax revenue per person. Educational funding was a major reason "blue" states were ahead of their "red" neighbors.

Keywords

Welfare States, Federal Transfers, politics

1. Introduction

The Center on Budget and Policy Priorities (2020) estimates that more than 25 percent of state revenues have evaporated because of the covid-19 pandemic. The Federal Reserve Bank in Cleveland estimated major losses at the state and federal levels (Whitaker, 2020). Unemployment neared 15% at one point (Long & Van Dam, 2020) as 40 million workers who lost jobs and filed for unemployment during the pandemic. To date Congress has approved 2 stimulus funding packages totaling over $3 trillion, with discussions or a third (already approved by the House of Representatives) (Foran et al., 2020).

However, this third stimulus is not without controversy. Senate Majority Leader Mitch McConnell called it a "blue state bailout," alluding to the fact that the Covid-19 virus had impacted Democratic states harder than Republican ones at that point (Lahut, 2020). In addition to McConnell, President Trump has often tweeted about the incompetence by local politicians in blue states, whom he also holds responsible for the economic harm wrought on their constituents (Trump tweet, 4/27/2020). He tweeted on April 27th: "Why should the people and taxpayers of America be bailing out poorly run states (like Illinois, as example) and cities, in all cases Democrat run and managed, when most of the other states are not looking for bailout help?" McConnell said he "would certainly be in favor of allowing states to use the bankruptcy route… We're not interested in rescuing them from bad decisions they've made in the past" (Frum, 2020). Former Florida Governor and current Senator Rick Scott weighed in that he was not supportive of helping any states that can't "balance its bloated budget without borrowing and consistently raising taxes to pay for its profligate spending." Scott added, "It's not fair to Florida citizens to send their tax dollars to bail out liberal politicians in states like New York for their unwillingness to make tough and responsible choices." Schultz, 2020). The same question was posed to Governor Kristi L. Noem of South Dakota who asked "why taxpayers in her state should bail out Illinois" (Bump, 2020).

Governor Cuomo of New York pointed out that New York, the hardest hit state early in the coronavirus pandemic, is a net payer to the rest of the country so federal funds are not a bailout but returns for years of payments to benefit others (Lahut, 2020). Senator Chris Murphy (2020) said in a tweet that "If Florida would like to have a conversation about making sure no state gets more money from the federal government than they send to it, Connecticut is ready." Arguments over which states are "better" comes down to an assumption that "red" states are more responsible in their operations than "blue" states, and that there is a net transfer of funds by "red" states to "blue" states. In addition, they argue that "blue" states are less efficient and productive than "red" states. A further argument is that low tax "red" states provide "more cost-effective services to their residents". Bump (2020) suggested that based on graphics developed by the Washington Post, "there's not a strong relationship between how red or blue a state is and how much it contributes or receives from the federal government on net." The question is whether there is merit to any of these regularly pontificated arguments?

The project attempted to use economic data to compare states with the intent of determining the following:

1. Can "red" or "blue," "payor" or "recipient," be predicted?
2. Are "red" states "better run" than "blue" states, meaning are "red" states more "productive," based on per capita incomes, gross domestic product and net federal tax transfers that "blue" states?

If the current dialogue is not correct, the can these same statistics reveal the truth, which will perhaps give some guidance how to correct the situation.

2. Methodology

The database was developed from a variety of online sources (see the data sources at the end of the paper). These data were used for the analyses with statistical techniques principal component analysis, correlation analysis and linear and logistic regression, with the goal of identifying:

1. Whether linear regression could be used to predict net inflow or outflow of federal funds with linear regression

2. Whether variables most likely to predict "red" or "blue" states with linear or logistic regression

3. If there are characteristics that define the prediction using principal component analysis

It should be noted that a critical issue associated with the statistical analysis used in this effort is the need for complete dataset. The following variables exist for every state in the dataset:

Variables
Federal Funding coming to state from Feds/person
Median Household Income
Per Capita Income 2018
SNAP PerCapita2019
infant mortality RATE/100K
Percentage of employment in manufacturing(p)
GDP per capita
State Pension Funded Ratio
% Required to be Contributed to state Pensions
Population 2018
% Pop growth- since 2010
Income growth
Total Per Pupil Spending
Instruction Spending Per Pupil
State Higher Education funding /person
% High school graduate
% Bachelor's degree
% Advanced degree
STEM Employment
STEM Degrees/100K
Fed tax Collections per person
Disability Employment Rate %

Black
Hispanic
American Indian/Alaska Native
Asian
Adults incarcerated/100K
Kids incarcerated/100K
State Welfare/person
S&L Health &Hospital Cost/person
S&L Highway cost/person
S&L Police/person
S&L Other/person
Unemployment % March 2020 (pre-covid19)
Healthcare Access Ranking
Health Care Affordability Ranking
Health Insurance Enrollment Ranking

Principal component analysis (PCA) was used to evaluate the which factors favored together. The principal component analysis method dates from Spearman (1904) and continues to develop (Jolliffe, 2002). PCA techniques are mainly used to reduce the dimensionality of p multi-attributes to two or three dimensions. The mathematics of PCA uses an orthogonal transformation convert observations of possibly correlated variables into a set of values of linearly uncorrelated variables called principal components (Pleitez, 2012; IOS, 2012). Two methods are commonly used for determining the number of factors to be used for interpreting the results: The Scree test (Cattell, 1966) is based on the decreasing curve of eigenvalues. The number of factors to be kept corresponds to the first turning point found on the curve. However, these representations are only reliable if the sum of the variability percentages associated with the axes of the representation space are sufficiently high. If this percentage is high (for example 80%), the representation can be considered as reliable. If the percentage is reliable, it is recommended to produce representations on several axis pairs in order to validate the interpretation made on the first two factor axes.

Ultimately the goal is to determine a consequence – i.e. "red" or "blue", incoming funds or net outflow of funds. Linear regression model provides a mechanism to model the data to determine if differences between the active and inactive projects exists. Linear and logistic regression were compared - logistic regression is generally the preferred technique when the dependent variable is binary in nature. Both regression models were run using XLSTAT®.

With regression models, the goal is to develop a series of weights for the independent variables (all variables to determine which variables meaningfully impact the outcome of success. Regression can be used as a tool to predict the likelihood of success (the dependent variable) using the current dataset. An

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odds ration table can be developed to determine the likelihood that the regression model correctly picks the actual result (which are binary). For the purposes of the modeling, "blue" states were assigned the value of 0, and "red" states a 1. Likewise, those states that are net outflow were assigned a value of 0, and the recipient states, 1.

3. Results

To start, a series of histograms were created to compare states. Figure 1 shows the states and their net federal flow of funds per capita. What this graph shows is that Kentucky and Virginia receive the most federal funding per capital than any other state (over $9,000/person). The states with a large net funding going out are Connecticut, Massachusetts, North Dakota, New York, New Jersey, while Illinois and Washington, while negative, are closer to net zero. The states near net even are California and Colorado. Texas and Utah are slightly positive. The rest of the states average a net influx of $4,000 per capita. States asking for help in the Covid 19 crisis? New Jersey, New York, California and Illinois, and net outflow states.
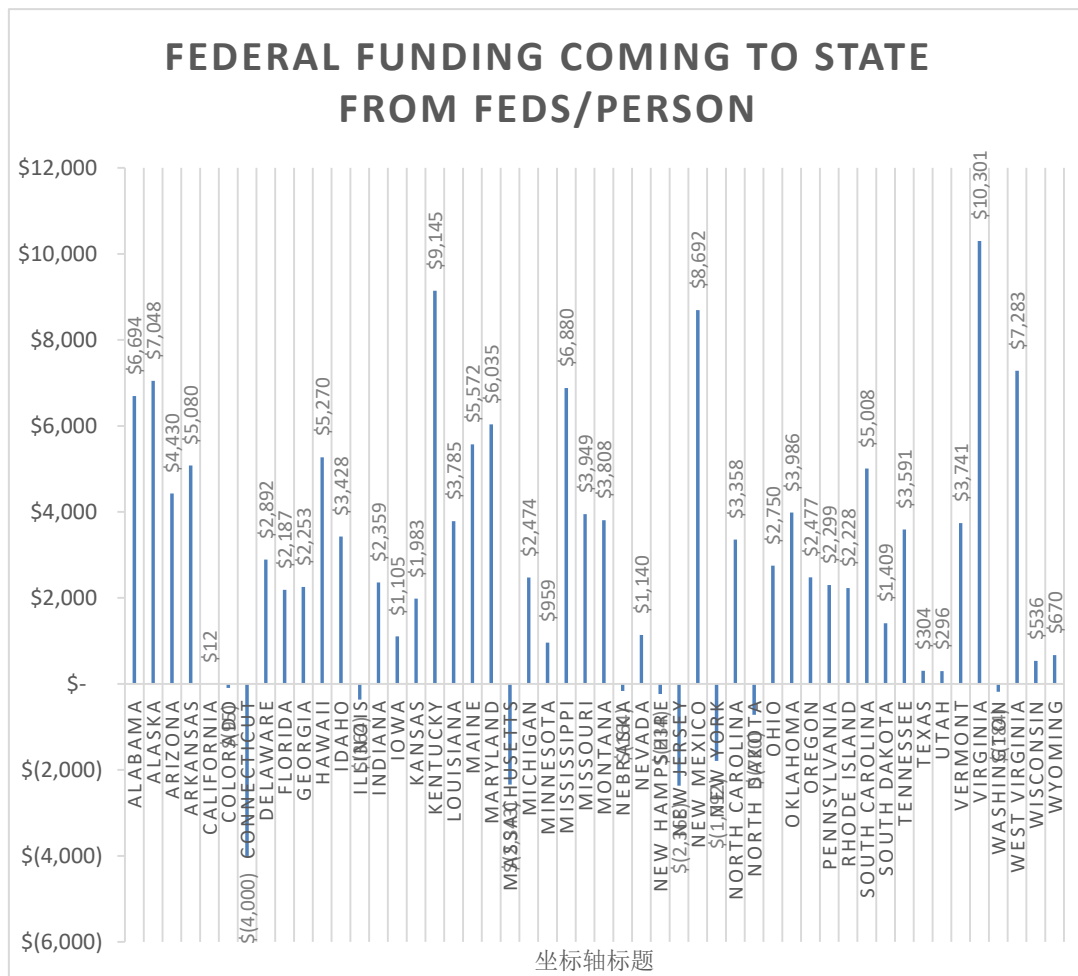

Figure 1. Net Federal Tax Flow

Next a histogram was developed for the gross domestic product (GDP) per capital. The results in Figure 2 shows that the GDP/capita is highest in many of these same states, plus Minnesota, Virginia, and Delaware. These states are productive. The third histogram was developed to shows whether these states are net payors because they have high income? The answer is to a degree, yes, although Alaska, Delaware and Wyoming are high income subsidized states, Alaska particularly so (see Figure 3). However, Alaska, Delaware and Wyoming are states with falling incomes over the past 5 years, and challenging budgets – Alaska is considering ending payments for oil since their Treasury is now broke. Note Connecticut also had a falling income as well for 3rd Quarter 2019.
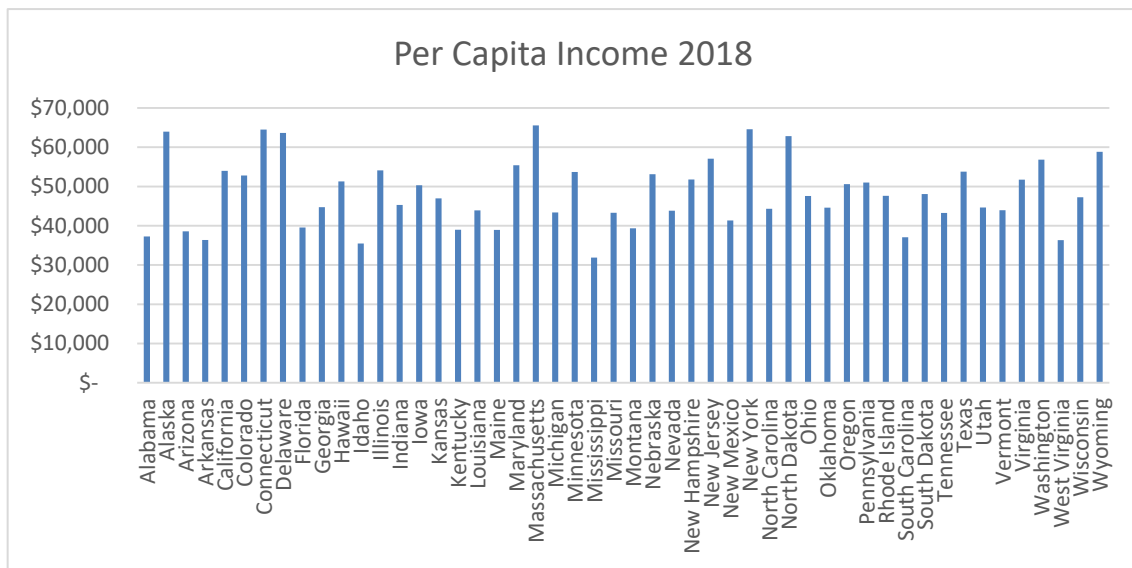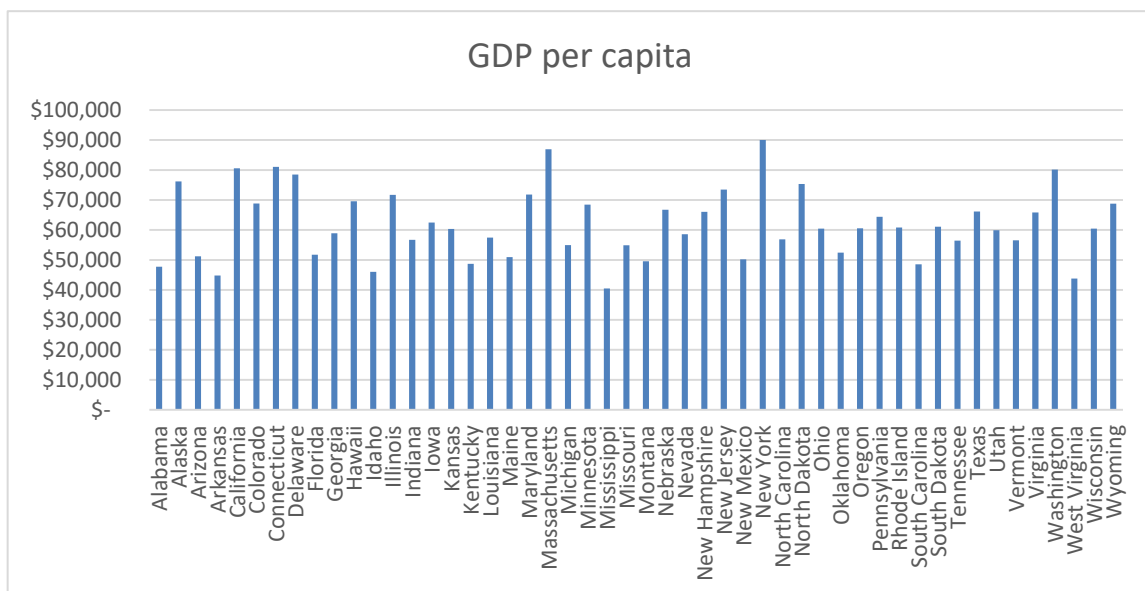

Figure 2. Income per Capita

Figure 3. GDP per Capita

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The next question is why these are high income states. Manufacturing and education are two possible reasons. Manufacturing normally provides well paying jobs as skills are required, but the figures do not represent this to be true as New York and New Jersey are in the lower half of the states. STEM employment requires skills, but generally requires post- secondary degrees. The college and advanced degrees do show that states with high incomes generally have higher percentages of the population with college (Figure 4) and advanced degrees (Figure 5 - Colorado, California, New York, New Jersey, Washington, Massachusetts, Connecticut, are included with the Washington DC area (Maryland and Virginia) added). If educational funding helps with employment, then looking at funding for education would be instructive. Highest funding for schools were in New York and Connecticut, along with Delaware, Vermont, and Alaska – the high values in Alaska may be related more to distance than other factors, so this value may not be instructive. The actual instructional cost per pupil is shown in Figure 6, which indicates that New York, Connecticut, Vermont, Alaska and Wyoming were highest. Good education and higher income jobs would appear to relate. Other states with higher overall average spending per capita include the high income states, plus some Vermont, Utah, Wyoming, Iowa (STEM work) and Kansas. These states also generally have lower unemployment. A review of higher education expenses per capita from state sources also indicates that more higher education spending does increase incomes (see Figure 7), although the data is very scattered. Of note higher education funding took major hits in the aftermath of the 2008 Recession.
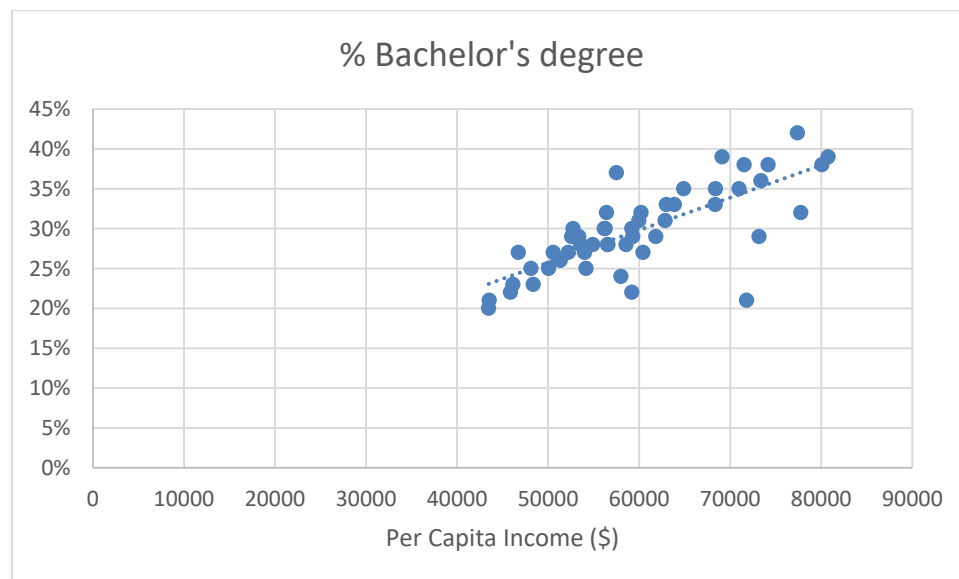

Figure 4. High Incomes Generally Have Higher Percentages of the Population with College
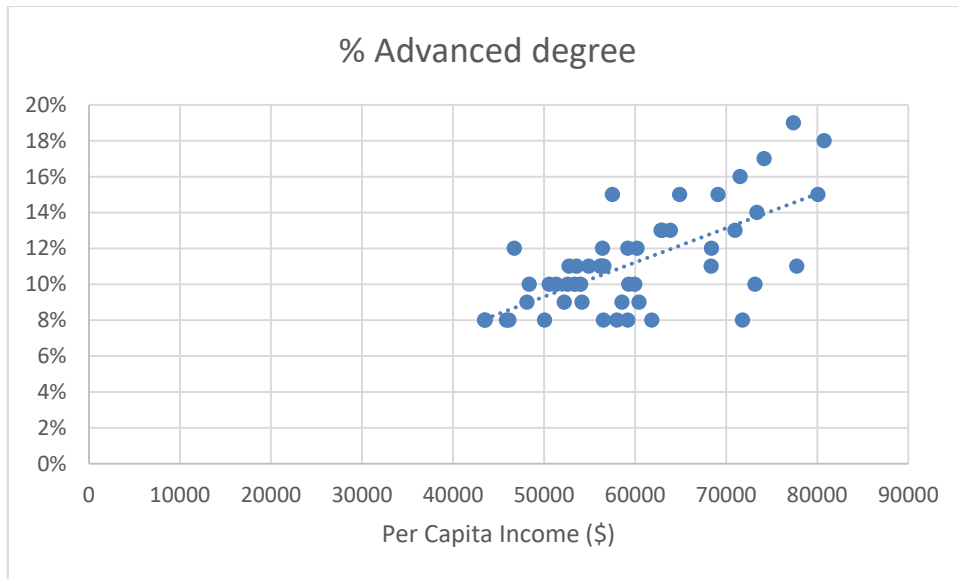
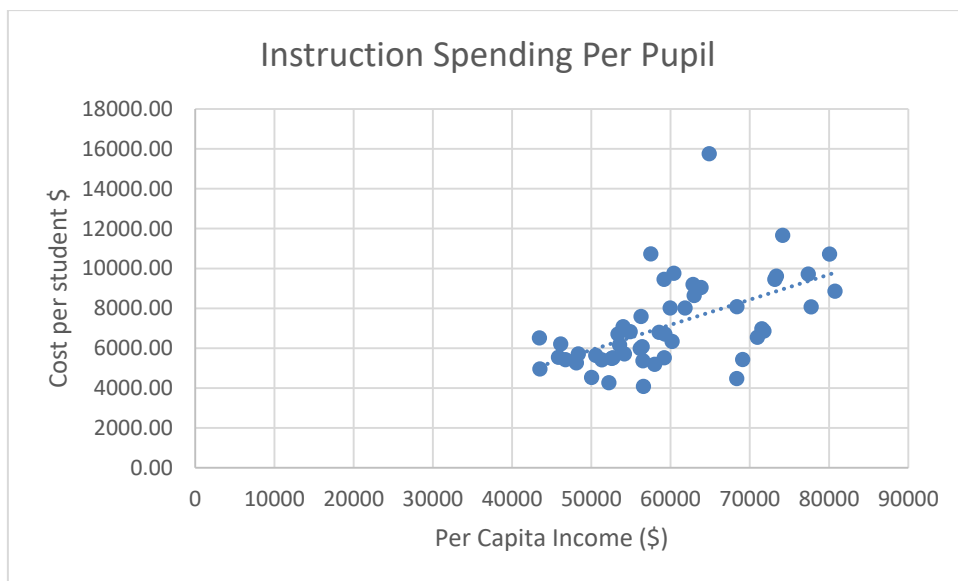**Figure 5. Advanced Degrees Awarded by States**

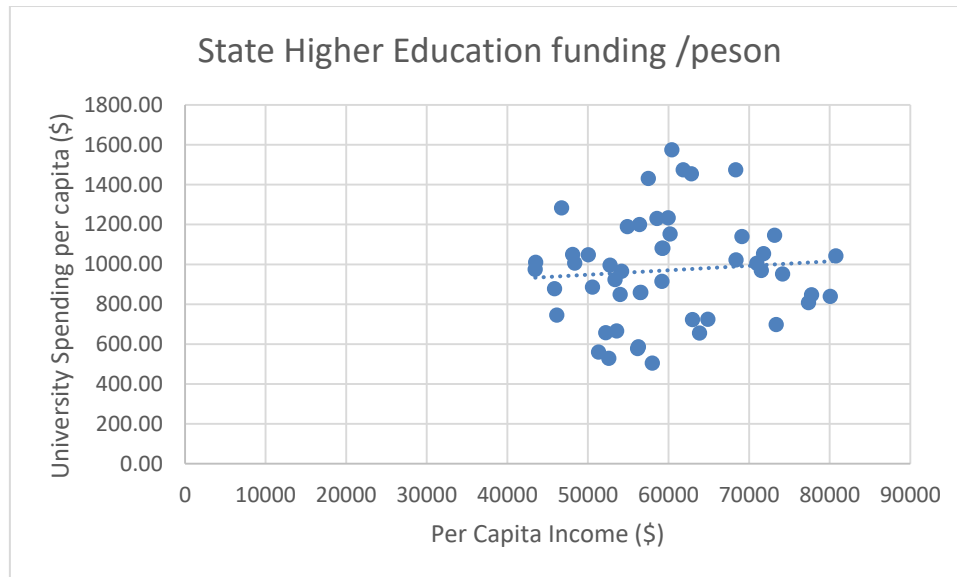**Figure 6. Educational Funding per Pupil per State**

Figure 7. Per Capita Funding for Higher Education

Other issues that may be related to states and whether or not they require federal flow funds: health conditions and access, state expenses, welfare recipients and incarcerations. In looking at the amount of funding needed to state and local funding for Roads, Police and Health Care, Alaska, North Dakota and Wyoming are highest, while the other high income state are most toward the average. When looking at incarcerations per 100,000 people, none of these states ranks high. Likewise looking at welfare transfers, as a means to evaluate the impact of the state budget, New York and California have higher than average transfers to protect vulnerable citizens. Those states also have high employment of disabled people. For the most part (except New Jersey) their health access scores are among the higher rankings as well. With respect to pension obligations, Illinois and New Jersey appear to have challenges (along with Kentucky), but New York and California are among the better funded pensions which is in contrast to current political rhetoric at the federal level.

Based on this data, the initial review suggests that certain states may be operated better than the political rhetoric may indicate, and therefore may provide better services to their populace based on wealth, GDP, education, health and other factors. Running Principal component analysis, the goal was simply to determine if there were consistent factors that made up the states that were payor. After conducting this analysis, the Scree plot indicated on factor that was nearly 40% of variance. It indicated that those that were net payors of funds had:

- Higher incomes

- Better healthcare (defined by access, cost and low infant mortality rates

- Higher spending per pupil

- Higher levels of education

- Fewer incarcerations, particularly of children

- Higher state and local spending on services including police

The results were the same for both eigenvalues and rotated results.

Running the linear regression models, the linear regression confusion matrix, which identifies whether the predicted value for payor or recipient correctly. The linear regression model predicted the correct result 100 percent of the time. A logistic model was run since the result being predicted was binary. Figure 8 shows the prediction of whether a state was a net payor or received of federal funds. The model correctly predicted the actual situation 100 percent of the time. The regression model was re-run based on being categorized as "Red" or "Blue" based on the overall results of Presidential elections since 1960, the model yielded a correct prediction 100 percent of the time (see Figure 9).
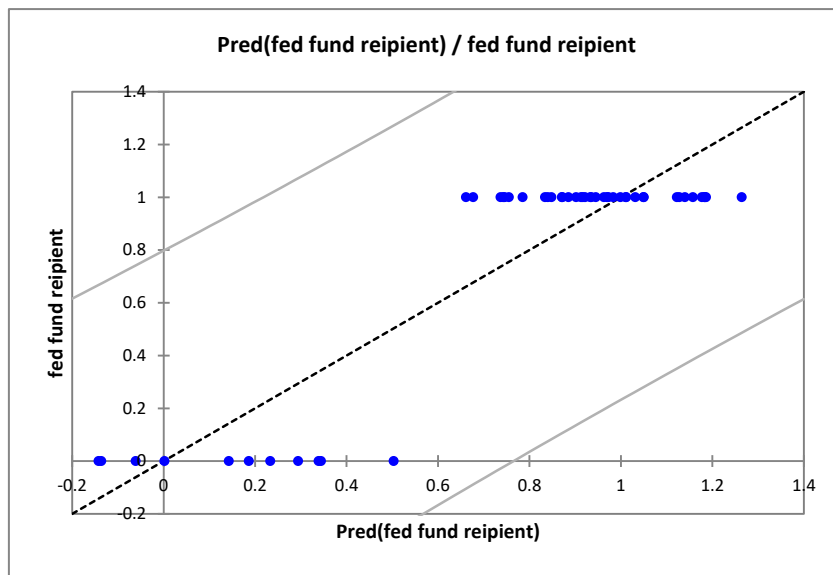

Figure 8. 100% Correct Prediction of Recipient or not of Federal Funds
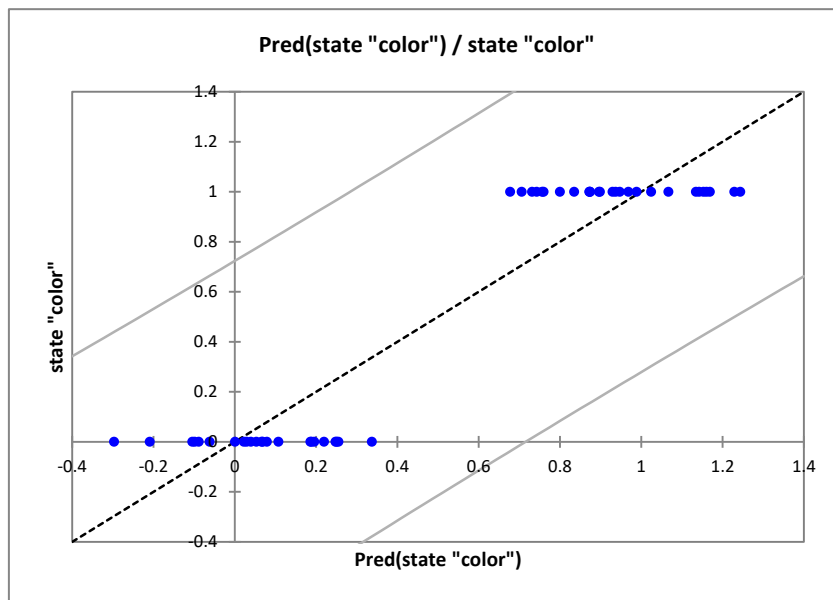

Figure 9. 100% Correct Prediction of Red or Blue State

The logistic model suggested that the full dataset might not be needed to predict the results. These results suggested that the number of variables could be reduced to:

GDP Per capita 2018

per capita income 2018

Population 2018

Instruction Spending Per Pupil

State Higher Education funding /person

Kids incarcerated/100K

S&L Health &Hospital Cost /person

S&L Highway cost /person

S&L Police /person

S&L Other /person

Running the linear regression models, the linear regression confusion matrix, which identifies whether the predicted value for payor or recipient correctly or state color, yielded a correct prediction 90 percent of the time. The logistic regression model was run for comparison and the resulting confusion matrix was also over 90 percent (see Tables 1 and 2). The resulting linear regression predictions are shown in Figure 10 and 11.

Running the linear regression models, the linear regression confusion matrix, which identifies whether the predicted value for payor or recipient correctly. The linear regression model predicted the correct result 90 percent of the time. A logistic model was run since the result being predicted was binary. The model correctly predicted the actual situation 94 percent of the time. The regression model was re-run based on being categorized as "Red" or "Blue" based on the overall results of Presidential elections since 1960, the model yielded a correct prediction 100 percent of the time, just like with the regression model above.

Table 1. Confusion Matrix Classification Table for the Correct Prediction of Variable "Fed Fund Recipient"

from \ to	0	1	Total	% correct
0	9	2	11	81.82%
1	1	38	39	97.44%
Total	10	40	50	94.00%

Table 2. Confusion Matrix Classification Table for the Correct Prediction of Variable "State Color"

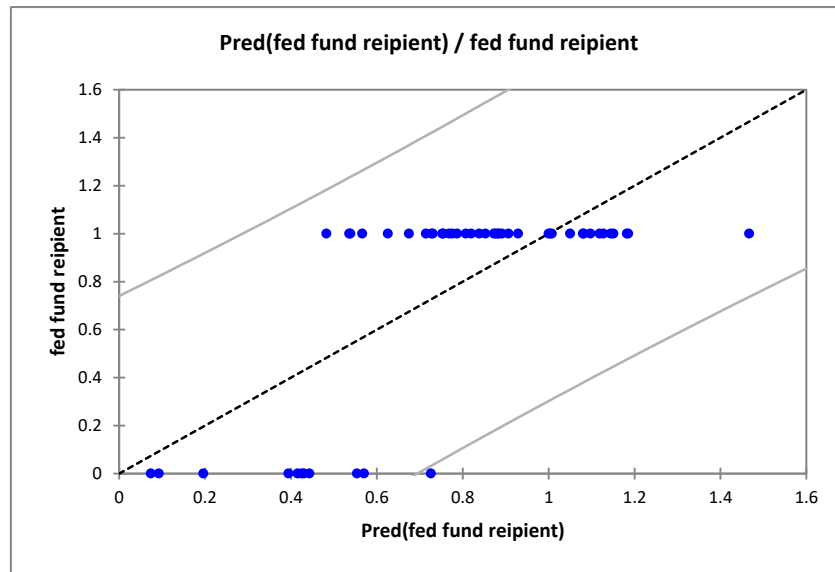| from \ to	0	1	Total	% correct
0	23	0	23	100.00%
1	0	27	27	100.00%
Total	23	27	50	100.00%

Figure 10. Reduced Variables Provided a 94% Correct Prediction of Inflow/Outflow of Federal Funds
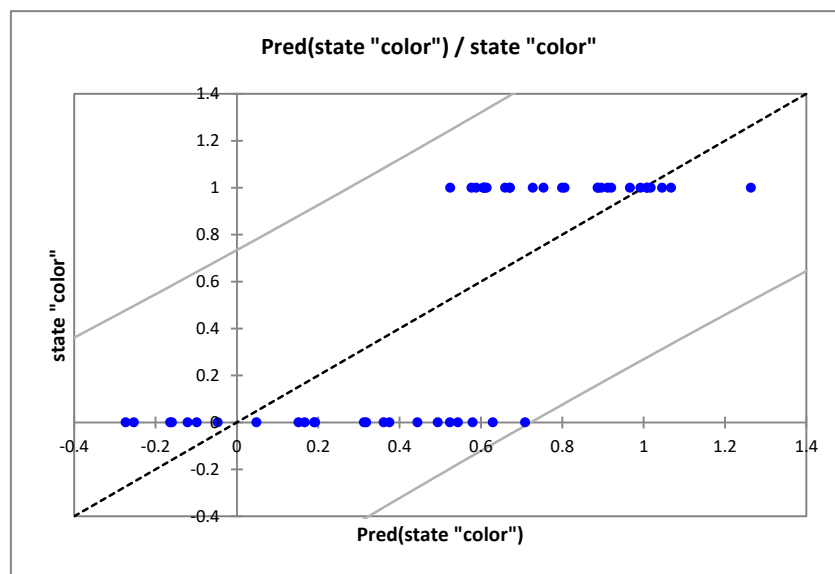

Figure 11. Reducing the Variables Indicated a 100% Correct Prediction of Recipient or non-recipient of Federal Funds

4. Discussion

Arguments over which states are "better" comes down to an assumption that "red" states are better more responsible in their operations that "blue" states, and that there is a net transfer of funds by "red" states to "blue" states. Aside from the fact that we are all in this together and we are all better off when everyone benefits in the long run, the question is – it this red-blue argument really true? The intent of this paper was to answer the following questions:

1. Can "red" or "blue," payor or recipient, be predicted?
2. Are "red" states "better run" than "blue" states, meaning are "red" states more "productive," based on per capita incomes, gross domestic product and net federal tax transfers that "blue" states?

The answer to the first question was clearly "yes," a model can be created using generally available data to predict whether a state was a net payor or recipient, and whether the state was categorized as "red" or "blue."

With respect to the question about being "better run," the incomes, education and gross domestic product per capita were higher for the "blue" states which were generally the same states that were net payors. Hence the "blue" states subsidize the "red" states. The grand experiment of reducing government in favor of letting private sector take over is clearly not working in "red" states. The result is that they all rely on net federal transfers of fund, including South Dakota, Florida and Kentucky, the states with elected officials arguing against state and local government bailouts. The truth appears to be as ex-Governor Cuomo stated, blue states are better run, better funded and are more productive than "red" states. In many cases the state taxes are higher in these states, but the taxes are used to benefit the greater whole as opposed to "red" states that appear to, and some of whom brag about, starving government. The states that talk the most about starving government are consistently recipients of federal funds.

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Data Sources:

Variables	Source
Federal Funding coming to state from Feds/person	https://www.usatoday.com/story/money/economy/2019/03/20/how-much-federal-funding-each-state-receives-government/39202299/
Median Household Income	https://www.usatoday.com/story/money/economy/2019/03/20/how-much-federal-funding-each-state-receives-government/39202299/
Per Capita Income 2018	https://en.wikipedia.org/wiki/List_of_U.S._states_and_territories_by_income
snapPerCapita2019	https://www.usatoday.com/story/money/economy/2019/03/20/how-much-federal-funding-each-state-receives-government/39202299/
infant mortality RATE/100K	https://www.cdc.gov/nchs/pressroom/sosmap/infant_mortality_rates/infant_mortality.htm
Percentage of employment in manufacturing(p)	https://www.bea.gov/data
GDP per capita	https://en.wikipedia.org/wiki/List_of_U.S._states_by_GDP_per_capita
State Pension Funded Ratio	https://www.pewtrusts.org/en/research-and-analysis/issue-briefs/2019/06/the-state-pension-funding-gap-2017#:~:text=The%20overall%20figure%20of%2069,total%2C%20were%2086%20percent%20funded.
% Required to be Contributed to state Pensions	https://www.pewtrusts.org/en/research-and-analysis/issue-briefs/2019/06/the-state-pension-funding-gap-2017#:~:text=The%20overall%20figure%20of%2069,total%2C%20were%2086%20percent%20funded.
Population 2018	https://www.governing.com/gov-data/census/state-minority-population-data-estimates.html
% Pop growth- since 2010	https://www.governing.com/gov-data/census/state-minority-population-data-estimates.html
Income growth	https://www.bea.gov/data/income-saving/personal-income-by-state
Total Per Pupil Spending	https://www.governing.com/gov-data/education-data/state-education-spending-per-pupil-data.html
Instruction Spending Per Pupil	https://www.governing.com/gov-data/education-data/state-education-spending-per-pupil-data.html
State Higher Education funding /peson	US Census Bureau. 2000, updated annually. Annual Survey of State and Local Government Finances, 1977-2017. Compiled by the Urban-Brookings Tax Policy Center. Washington, DC: Urban-Brookings Tax Policy Centers (2017).
% High school graduate	https://en.wikipedia.org/wiki/List_of_U.S._states_and_territories_by_educational_attainment
% Bachelor's degree	Bureau, U.S. Census. "2013-2017 American Community Survey 5-Year Estimates". factfinder.census.gov.
% Advanced degree	https://en.wikipedia.org/wiki/List_of_U.S._states_and_territories_by_educational_attainment
STEM EMPLOYMENT	https://ncses.nsf.gov/indicators/states/indicator/technical-workers-to-all-occupations/table
STEM Degrees/100K	https://public.tableau.com/vizql/w/STEMGradutes/v/TotalSTEMGraduatesbyState/viewData/sessions/9267E7C0625E4AE48C2044EACEF16732-0:0/views/4633765943959456334_17520096532962874542?maxrows=200&viz=%7B%22worksheet%22%3A%22Total%20Stem%20Graduates%20by%20State%22%2C%22dashboard%22%3A%22Total%20STEM%20Graduates%20by%20State%22%7D
Fed tax Collections per person	https://www.irs.gov/statistics/soi-tax-stats-gross-collections-by-type-of-tax-and-state-irs-data-book-table-5

Variables	Source
Disability Employment Rate %	https://www.disabled-world.com/disability/statistics/2019-chart.php
Black	https://www.governing.com/gov-data/census/state-minority-population-data-estimates.html
Hispanic	https://www.governing.com/gov-data/census/state-minority-population-data-estimates.html
American Indian/Alaska Native	https://www.governing.com/gov-data/census/state-minority-population-data-estimates.html
Asian	https://www.governing.com/gov-data/census/state-minority-population-data-estimates.html
Adults incarcerated/100K	https://en.wikipedia.org/wiki/List_of_U.S._states_and_territories_by_incarceration_and_correctional_supervision_rate
Kids incarcerated/100K	https://www.bjs.gov/index.cfm?ty=pbdetail&iid=6226
State Welfare/person	US Census Bureau. 2000, updated annually. Annual Survey of State and Local Government Finances, 1977-2017. Compiled by the Urban-Brookings Tax Policy Center. Washington, DC: Urban-Brookings Tax Policy Centers (2017).
S&L Health &Hospital Cost/person	US Census Bureau. 2000, updated annually. Annual Survey of State and Local Government Finances, 1977-2017. Compiled by the Urban-Brookings Tax Policy Center. Washington, DC: Urban-Brookings Tax Policy Centers (2017).
S&L Highway cost/person	US Census Bureau. 2000, updated annually. Annual Survey of State and Local Government Finances, 1977-2017. Compiled by the Urban-Brookings Tax Policy Center. Washington, DC: Urban-Brookings Tax Policy Centers (2017).
S&L Police/person	US Census Bureau. 2000, updated annually. Annual Survey of State and Local Government Finances, 1977-2017. Compiled by the Urban-Brookings Tax Policy Center. Washington, DC: Urban-Brookings Tax Policy Centers (2017).
S&L Other/person	US Census Bureau. 2000, updated annually. Annual Survey of State and Local Government Finances, 1977-2017. Compiled by the Urban-Brookings Tax Policy Center. Washington, DC: Urban-Brookings Tax Policy Centers (2017).
unemployment % March 2020 (pre-covid19)	https://www.bls.gov/web/laus/laumstrk.htm
healthcare access ranking	https://www.usnews.com/news/best-states/rankings/health-care/healthcare-access
HEALTH CARE AFFORDABILITY ranking	https://www.usnews.com/news/best-states/rankings/health-care/healthcare-access
HEALTH INSURANCE ENROLLMENT ranking	https://www.usnews.com/news/best-states/rankings/health-care/healthcare-access