IMPACTS OF MINIMUM WAGE & EDUCATION SPENDING ON STATE ECONOMY IN THE U.S.

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ABSTRACT

This paper explores impacts of minimum wage & education spending on state economy in the United States. We propose two research hypotheses. States with higher minimum wages are expected to perform significantly better. States with greater spending on K-12 education are expected to perform significantly better. To measure the State economic performance, we employ the data envelopment analysis model, using three input variables (state government employee payroll, number of State government employees, state population) and two outputs (unemployment rate, & per capita income). The relative efficiency score by the DEA model serves as the State economic performance measure. Mann-Whitney test results on the 2012 economic data reveal no statistical significances on the first hypothesis (the minimum wage) while evidence supports the second hypothesis. We also discuss policy implications and practical applications.

INTRODUCTION

In December of 2007, the United States found itself facing the start of the Great Recession. A subprime mortgage and financial crisis sent the world's economies into a tailspin. Due to lack of revenue and capital for investment, corporate empires began to crumble. This in turn forced many organizations to lay off workers and put a freeze on hiring. Government tax revenue declined, putting a strain on budgets. The US unemployment rate rose from 4.4% in October of 2006 to 9.5% in April of 2010.

It has been almost a decade since the recession began, but today we still find ourselves reeling from its effects. Government policy makers pursued a variety of measures to deal with the causes and effects of the recession, both in the financial services industry and in the wider economy. Not surprisingly, lawmakers continue to question public policy decisions such as minimum wage and per pupil spending, and the effects that those decisions have on their state's economy, particularly their unemployment rate and per capita income. This paper focuses on those key variables. Using a Data Envelopment Analysis (DEA) Model, we hope to find answers to many of these questions, which can provide guidance to policymakers. We describe the DEA model in detail in the methodology section.

In July of 2009, the federal minimum wage went to $7.25 for all covered, nonexempt workers. However, states have the power to set their own minimum wage above that of the federal minimum. Today there are 28 states, plus the District of Columbia, that have minimum wages above the federal minimum wage level, although this number was lower in the specific years studied in our analysis. While minimum wage is always a significant public issue, in recent years it has emerged as a particularly important political issue, with many people arguing that an increase in minimum wage is needed to help people recover from the recession. While an increase in minimum wages should clearly increase per capita income, there is considerable debate about this, as well as its effect on unemployment. Some lawmakers have been arguing for years that an increase in minimum wages will only result in an increase in company costs, and if consumers are not willing to pay for that company's increase in costs, then that company will ultimately end up having to lay off employees, thereby increasing the state's unemployment rate and lower per capita income. Through use of the DEA Model, we hope to address these arguments and provide a useful statistical framework for analyzing these issues.

In addition to the federal minimum wage and its effect on unemployment and per capita income, we also investigate the correlation between states' per pupil spending and its effect on unemployment and per capita income. It would seem to be a plausible hypothesis that states which invest in the education of their children would see some benefits in employment and income.

We are not aware of any DEA models addressing these four issues and their relationship to one another, and, as such, we hope our research provides new insight into these important public policy issues.

Using data from the United States Census Bureau, the Bureau of Labor Statistics, the Department of Labor and gathered white papers and articles, we plan to create a model assessing minimum wages and per pupil spending for each of the 50 states plus the District of Columbia, and their potential effects on each state's unemployment rate and their per capita income.

The next section contains a brief review of prior studies related to our analysis. In the third section, we provide the methodology followed by the statistical results from the DEA models in the fourth section. The fifth section discusses those results. We put our conclusions in the last section of this paper.

REVIEW OF PRIOR STUDIES

Minimum Wage

Policymakers, experts and people in general have been arguing about the effects of minimum wage hikes since the Fair Labor Standards Act of 1938 went into effect some 77 years ago. On June 24, 1938, just prior to signing the FLSA into law, President Franklin Roosevelt stated in one of his "fireside chats:" "Do not let any calamity-howling executive with an income of $1,000 a day, ...tell you...that a wage of $11 a week is going to have a disastrous effect on all American industry" (Roosevelt, 1938). While there have been countless studies related to what effect, if any, each increase in the minimum wage will have on industry, few, if any, studies have attempted to prove a correlation between higher minimum wages and lower unemployment/higher per capita income.

This quote from President Roosevelt upon the creation of a federal minimum wage raises an important issue which affects the study of criteria such as minimum wage and per pupil spending. These are high politicized issues. Many of the arguments made for or against increases in these variables are done so in the context of political arguments and there is considerable money and effort spent by private interests in trying to prove or disprove a correlation between things like increases in minimum wage and benefits to society. Our analysis will hopefully provide some useful information from a disinterested perspective.

Early on, almost all of the studies focused primarily on the federal minimum wage and what effect it would have on the national economy, but such an analysis today would almost be irrelevant considering the fact that most larger population states have laws that set minimum wages in excess of the federal minimum wage. Gitis (2014) conducted a study looking at the effects of minimum wage on unemployment rates and job creation. He performed an analysis of states' minimum wages and its effects on states' unemployment rates and job creation. He looked at teenage unemployment rate specifically, since teens are the most likely to have a minimum wage job. He also examined education and the relationship between education and minimum wage. He used minimum wage data provided by the federal Bureau of Labor Statistics and education data provided by the Census Bureau. His results showed that a higher minimum wage had a negative impact on job creation throughout the US. Another conclusion reached by Gitis is that the teenage job market is the most effected by increases in minimum wage, with their unemployment rates above 20%.

Wolcott (2014), along with his colleagues at CEPR, utilized a study conducted by Goldman Sachs following minimum wage increases in 13 states in the beginning of 2014 to examine the effect on employment rates. They compared the minimum wage increases in the 13 states with the rest of the country. In a finding at odds with Gitis, they found that employment rose faster in the 13 states with increases in minimum wage.

Other studies have addressed the impact of an increase in minimum wage at the state level, even taking that further and taking into account the fact that an increase in minimum wage does not affect everyone. For example, Card (1992) commented on the effect of California's increase in minimum wage from $3.35 to $4.25 in 1988. During the previous year, 11% of workers in the state and 50% of California teenagers had earned less than the new state minimum. Using data from published sources and the Current Population Survey, Card compared changes in the labor market outcomes of California workers to the corresponding changes in states that did not increase in the minimum wage. The minimum wage increase raised the earnings of low-wage workers by 5–10%. Card's research showed that there was no decline in teenage employment, or any relative loss of jobs in retail trade, despite the many predictions to the contrary. Card and Krueger (1993) reported the effect of minimum wage on employment in the fast food restaurant industry.

Neumark, Salas and Wascher (2014) commented on the debate over the effects of minimum wage on employment. They analyzed recent research on the topic and strongly disagreed with some of the methodologies used by other researchers, in particular how different groups were constructed. Overall, they disagreed with recent articles that found no negative effects on employment as a result of increased minimum wage. While recognizing the difficulty of studying heterogeneous groups, they came to the conclusion that increases in minimum wage do have a negative effect on employment, even though some workers benefit from the higher wages. They conclude that there is essentially a trade-off between benefits for some in the form of higher wages, and harm to others in the form of unemployment.

There do not appear to be any studies directly analyzing the impact an increase in minimum wage would have on per capita income. However, there have been studies conducted at the national level which provide some framework for approaching this topic.

Education Spending

Afonso, Schuknecht and Tanzi (2010) conducted a study examining the effects of income distribution on education in OECD countries. They looked at standardized testing scores and the value of public educational systems to see if higher income distribution resulted in better education. The US ranked 4th in their model in both the input and output categories. They used public spending as a percentage of GDP for their input data. They used the Gini coefficient, which represents the income distribution of a country, as their output data. Their DEA model showed that countries with a relatively equal income distribution had better public education systems. We anticipate a similar result on a state by state level within the US.

There do not appear to be any studies directly addressing whether states with higher per pupil spending realize lower unemployment or an increase in per capita income. Examination of per pupil spending as a variable has led to conflicting results. Coulson (2014) prepared a report for the Cato Institute that compared state spending with student achievement. This report concluded that "There has been essentially no correlation between what states have spent on education and their measured academic outcomes." In response to Coulson and others, Bruce Baker from the Albert Shanker institute then reported issued findings from his study entitled "Does Money Matter in Education" that completely contradicted that of the CATO Institute. Baker concluded that, "[o]n average, aggregate measures of per-pupil spending are positively associated with improved or higher student outcomes. In some studies, the size of this effect is larger than in others and, in some cases, additional funding appears to matter more for some students than others. Clearly, there are other factors that may moderate the influence of funding on student outcomes, such as how that money is spent – in other words, money must be spent wisely to yield benefits. But, on balance, in direct tests of the relationship between financial resources and student outcomes, money matters."

The National Education Association, which is the largest labor union in the United States produces periodic Rankings and Estimates through NEA Research. This is a combined report on resources committed to public education. The 2014 edition contained Ranking of the States for 2013 and Estimates of School Statistics for 2014, with data presented state by state, including government financing and public schools. The Estimates 2014 section of the report looks at projections of the finances related to public education. In the Rankings section of the report, it shows that the average expenditure per student for public schools was $10,938 for the 2012-2013 school year. On a state-by-state basis, the report shows the total personal income data, which shows a substantial effect on the resources available to schools through taxation. The report shows fairly stable government revenues over the last decade and increased federal schooling funding. They show that government funding can be seen as indicators of a state's effort to fund the public education system. The Estimates section of the report shows that expenditures per student were expected to rise by 4% to $11, 373 for the 2013-2014 school year. State governments were expected to hold the largest share of funding for the public education system at 46.4%; while the federal government's share rose to 10.5%. "The federal, state and local revenue contributions for public education for 2013-14 are estimated at $65.1 billion, $287.6 billion and $266.9 billion, respectively, totaling $619.6 billion." National Education Association, 2014.

The conflicting studies described above indicate the extent to which scholarship in this area is greatly affected by think tanks and organizations who may be seen as having a predisposition to certain findings. It seems safe to say that it remains unsettled whether increases in per pupil spending will yield higher test scores. By using a DEA model analysis, however, we hope to settle the question of whether increases in per pupil spending can result in an increase in per capita income.

A starting point for this analysis begins with Frohlich (2014) in which he analyzed and compared per capita income with per pupil spending. The report concluded that, "[t]he nation's highest spenders on education were disproportionately in the Northeast, while the states spending the least tended to be in the Southern or Western U.S." The report also stated that spending could be driven by a range of factors, including state size, labor costs, and geography, noting that rural schools can often incur higher transportation costs.

Household earnings appear to play a major role in determining statewide school spending. The states that spent the most per student also had some of the wealthiest households. Median household income in all of the 10 top spending states was higher than the U.S. median. Among the states spending the least, only Utah households earned more than the national median of $51,371 in 2012, as reported by U.S. Census Bureau statistics. A major problem with this analysis is that it doesn't sufficiently explain a proper cause and effect analysis, i.e. does higher per pupil spending result in an increase in per capita income, or is higher per pupil spending just a byproduct of states that already have a higher per capita income?

The problem with these analyses are that there are so many other factors that are virtually impossible to quantify. For example, economic policies, development incentives, location, industry variations, etc. all play a role in per capita income. Perhaps student performance is the only true measure of predicting the ROI of per pupil spending? Our analysis uses these four criteria because they are some of the only examples of hard data available for each state that is collected using consistent methodologies.

METHODOLOGY

Variables and Hypotheses

For our analysis, we chose four commonly used benchmarks for comparing states. Our inputs are minimum wage and per pupil spending. Outputs are unemployment rate and per capita income. The inputs represent things over which state policy makers have some degree of control, and the outputs are goals that these same policy makers are trying to attain. We note that for use in the DEA software, the unemployment rate was converted to an employment rate (100% - Unemployment Rate) so that the data analysis would work correctly where a higher number is associated with a more desirable outcome. Also, we note that our data included the 50 states plus the District of Columbia, but for convenience, we will identify each of the decision making units as "states."

We also note that our designated independent variable inputs, in particular per pupil spending, cannot be expected to have an immediate same-year effect on the dependent variable outputs. Spending on a student's education today will not directly affect his income or employment opportunities until he reaches the workforce some years later. Rather, our inputs should be considered proxies for other data that is not so readily accessible. In this regard, per pupil spending can instead be seen as a proxy for the commitment that a state has to primary and secondary education. Similarly, minimum wage rates can be seen as a proxy for a state's concern about low wage workers.

As the literature discusses, there are ongoing debates about minimum wage and per pupil spending. Advocates for increases in each will often argue that such increases will in fact cause positive economic outcomes. Neumark, Salas and Wascher (2014) and others have argued that there are positive correlations between these two inputs and the two chosen outputs. Berger and Fisher (2013) maintained that a well-educated workforce was key to State prosperity.

Thus, we hypothesize that minimum wage and pupil education spending will make positive impacts on the State economy. We propose the two hypotheses as follows.

Hypothesis 1: If a State sets a higher minimum wage, the State will perform better economically.

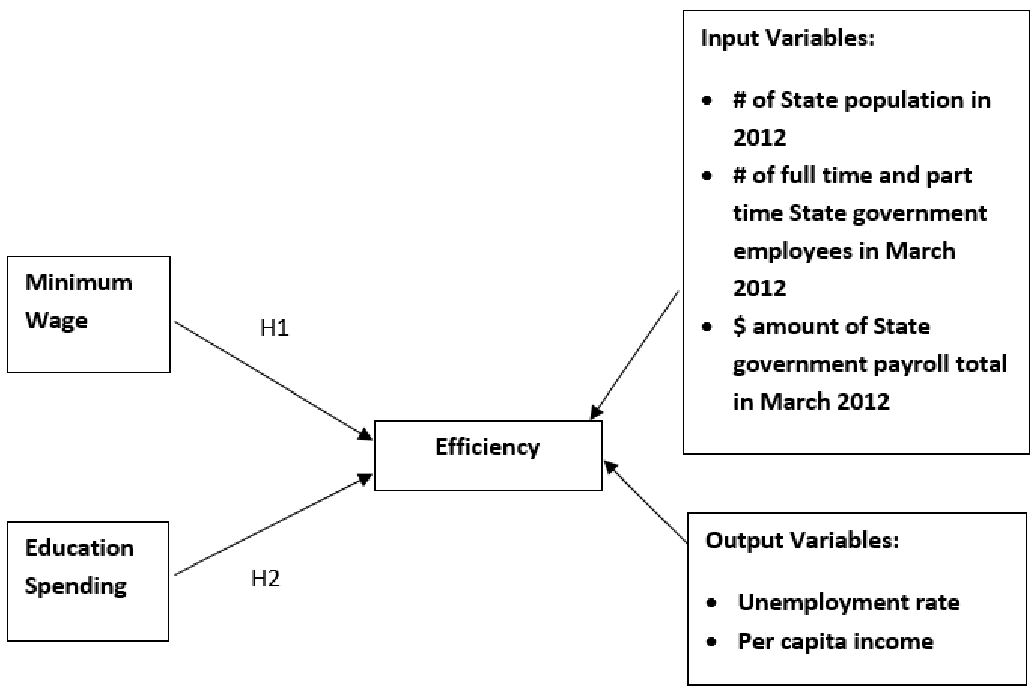
Hypothesis 2: If a State budgets a higher per pupil spending, the State's economy will be better.

To test the first hypothesis, we categorize 50 States into two groups. 25 States with lower minimum wages will belong to the control group (Group 1). The remaining 25 States with higher minimum wages will be put into the test group (Group 2). The economic performance of each State is measured by the data envelopment analysis model. The objective function value generated by the DEA model indicates a relative efficiency score of each State, given the inputs and outputs. The relative efficiency score serves as a proxy for the economic performance of each State. To conduct the hypothesis testing, we employ Mann-Whitney U test to compare the two groups in term of their rank mean.

Research Framework.

Our research involved assembling data on each of the five variables for each state for each of the years 2011 and 2012. We felt it would be useful to compare different years to further test whether increases in inputs positively affected outputs. The research framework is shown in Figure 1.

Figure 1. Research Framework



Data Envelopment Analysis Model

We employ data envelopment analysis (DEA) for measuring the comparative efficiencies of States in the U.S. The DEA model is a special application of linear programming based on frontier methodology of Farrell (1957). Since Farrell, major breakthrough for developing DEA was achieved by Charnes, Cooper, and Rhodes (1978) and by Banker, Charnes, and Cooper (1984). Data envelopment analysis is a useful approach for measuring relative efficiency among similar organisations or objects. An entity that is an object to be measured for efficiency is called a decision-making unit or DMU. Because DEA can identify relatively efficient DMU(s) among a group of given DMUs, it is a promising tool for comparative analysis or benchmarking (Mhatre, Joo, & Lee, 2014).

To explore the mathematical property of DEA, let E_0 be an efficiency score for the base DMU *0* then,

$$\text{Maximize } E_0 = \frac{\left\{\sum_{r=1}^{R} u_{r0} y_{r0}\right\}}{\left\{\sum_{i=1}^{I} v_{i0} x_{i0}\right\}} \quad (1)$$

subject to

$$\frac{\left\{\sum_{r=1}^{R} u_{r0} y_{rk}\right\}}{\left\{\sum_{i=1}^{I} v_{i0} x_{ik}\right\}} \leq 1 \text{ for all } k \quad (2)$$

$$u_{r0}, v_{i0} \geq \delta \text{ for all } r, i, \quad (3)$$

where

y_{rk}: the observed quantity of output r generated by unit k = 1, 2, …, N,
x_{ik}: the observed quantity of input i consumed by unit k = 1, 2, …, N,
u_{r0}: the weight to be computed given to output r by the base unit *0*,
v_{i0}: the weight to be computed given to input i by the base unit *0*,
δ: a very small positive number.

The fractional programming model can be converted to a common linear programming (LP) model without much difficulty. A major assumption of LP is a linear relationship among variables. Accordingly, an ordinary LP for solving DEA utilizes a constant returns-to-scale so that all observed production combinations can be scaled up or down proportionally (Charnes, Cooper, and Rhodes 1978). However, when we use a piecewise LP, we can model a non-proportional returns-to-scale such as an increasing, decreasing or variable-returns-to-scale (Banker, Charnes, and Cooper 1984). Depending on returns-to-scales and/or various modeling approaches, different types of DEA models are available (Mhatre et al., 2014).

Sherman and Ladino (1995) summarize the capability of DEA in the following manner:

- *Identifies the best practice DMU that uses the least resources to provide its products or services at or above the quality standard of other DMUs;*
- *Compares the less efficient DMUs to the best practice DMU;*
- *Identifies the amount of excess resources used by each of the less efficient DMUs;*
- *Identifies the amount of excess capacity or ability to increase outputs for less efficient DMUs, without requiring added resources.*

In this study, involving comparative measures of operational efficiencies for DMUs, a Charnes-Cooper-Rhodes (CCR) model, a Banker, Charnes, and Cooper (BCC) model, and a slack-based measure of efficiency (SBM) are employed. First, we measure the efficiency of DMUs using the CCR and BCC models respectively. Next, we apply SBM to data to evaluate the efficiency of variables with non-radial properties. Finally, we try to identify the sources of inefficiency by contrasting the results of three models. To address the validity and reliability issues on the sample data and DEA model, we aggregate the results of CCR, BCC and SBM models (Mhatre et al., 2014).

Data Collection

The data was all accumulated from public databases available from websites maintained by the United States government. Minimum wage rates were obtained from the Department of Labor. Per pupil spending figures are collected by the Census Bureau. Employment data comes from the Department of Labor. Per capita income also comes from the Census Bureau.

State employment and payroll data in March 2012 are collected from the U.S. Census Bureau in its website: 2012 Census of Governments: Employment.

http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=bkmk

RESULTS

Appendix 1 shows the sample data including the three input variables and two output variables per each State in 2012. Appendix 2 shows the sample data grouped by the minimum wage control variable. Group 1 indicates States with the federal minimum wage. Group 2 includes States with higher minimum wages than the federal minimum wage. Group 1 serves as the control group while we treat Group 2 as the test group.

Table 1 reports the results of bilateral DEA models using the minimum wage as a grouping variable. As the table shows, the 2012 economic data does not support the first hypothesis. All four bilateral DEA models (bilateral CCR-I, bilateral BCC-I, bilateral SBM-C, and bilateral SBM-V models) report no statistical significance ($p>0.05$). The higher minimum wage did not make significant impacts on the State economy. Indeed, the test group is worse than the control group. The rank means of all four models show the test group's rank mean is higher than the control group's rank mean, indicating the control group outperforms the test group. Appendix 3 shows the full report per each State.

Table 1
BILATERAL DEA MODEL RESULTS ON MINIMUM WAGE IN 2012

	Bi-CCR-I	Bi-BCC-I	Bi-SBM-C	Bi-SBM-V
# of States in Control Group (n_1)	32	32	32	32
Rank Sum of Control Group	770	782	787	796
Rank Mean of Control Group	24.0625	24.4375	24.5937	24.875
# of State in Test Group (n_2)	18	18	18	18
Rank Sum of Test Group	505	493	488	479
Rank Mean of Test Group	28.0555	27.3888	27.1111	26.1111
Mann Whitney U Test Statistic	-0.9297	-0.6871	-0.5861	-0.4042
p-value (one-tailed)	0.0881	0.1229	0.1394	0.1715

Note: Control Group includes 32 States at the federal minimum wage. Test Group includes 18 States with higher minimum wages than the federal minimum wage in 2012.

To test the second hypothesis, we first computed the overall average of the pupil education spending amount of all 50 States. The 2012 data presents $10,966.65 as the overall average. Accordingly, we grouped the sample data by the pupil education spending amount. Group 1 (control group) is the States with lower pupil education spending than the overall average ($10,966.65) while Group 2 (test group) is the States with higher pupil education spending than the overall average. Appendix 4 reveals the full data.

Table 2 reports the results of bilateral DEA models using the education spending as a grouping variable. As the table shows, data supports the second hypothesis ($p<0.01$). Appendix 5 shows the full report per each state.

Table 2
BILATERAL DEA MODEL RESULTS ON EDUCATION SPENDING $ IN 2012

	Bi-CCR-I	Bi-BCC-I	Bi-SBM-C	Bi-SBM-V
# of Control Group (n_1)	25	25	25	25
Rank Sum of Control Group	758	870	751	889
Rank Mean of Control Group	30.32	34.8	30.04	35.56
# of Test Group (n_2)	25	25	25	25
Rank Sum of Test Group	517	405	524	386
Rank Mean of Test Group	20.68	16.2	20.96	15.44
Mann Whitney U Test statistics	2.3380	4.5111	2.2022	4.8798
p value (one tailed)	0.0048	0.0000	0.0069	0.0000
Note: Control Group includes 25 States with lower pupil education spending than the overall average, while Test Group includes ones with higher spending.				

We can determine a ranking of each State in terms of the relative efficiency scores from four bilateral DEA models. First, we compute the rank sum by adding the four ranks per each state. Then, we can sort the data by the rank sum. A State with the lowest rank sum is considered the top rank in the relative efficiency. State rankings are listed in the following table. As shown in the table, top 10 most efficient States are Wyoming, Vermont, Alaska, North Dakota, New Hampshire, Delaware, Rhode Island, South Dakota, Maine, Hawaii. Among the top 10 States, only South Dakota belongs to Group 1 (Low Education Spending), while the rest of nine States belong to Group 2 (High Education Spending). Table 3 reports the top 10 States which are ranked by the four bilateral DEA models. The bilateral DEA models used the 2012 data grouped by the education spending. Appendix 6 reports the rankings of all 50 States.

Table 3
TOP 10 STATES RANKED BY DEA MODEL RESULST ON EDUCATION SPENDING IN 2012

DMU	Group	Bi-CCR-I	Bi-BCC-I	Bi-SBM-C	Bi-SBM-V	Rank Sum	Total Rank
Wyoming	2	1	4	1	1	7	1
Vermont	2	2	4	2	2	10	2
Alaska	2	3	4	3	3	13	3
North Dakota	2	4	4	4	4	16	4
New Hampshire	2	6	4	6	6	22	5
Delaware	2	5	4	5	10	24	6
Rhode Island	2	8	1	8	9	26	7
South Dakota	1	7	3	7	18	35	8
Maine	2	10	2	10	16	38	9
Hawaii	2	11	4	13	12	40	10

The analysis uses data available from several agencies of the United States government. All 50 states and the District of Columbia were included as decision making units. For convenience, we will refer to the 51 DMUs as “states.” Minimum wage data was obtained from the Department of Labor. Per pupil spending data came from the Census Bureau. Employment data is from the Bureau of Labor Statistics. Per capita income data is also from the Census Bureau. Data for each variable was separately analyzed for the years 2011 and 2012 to provide some comparable data. Employment rate data was modified. The Bureau of Labor Statistics produces an unemployment rate. For the purposes of DEA analysis, we converted the unemployment rate to an employment rate (100% – Unemployment Rate). This was necessary so that the more desirable output (lower unemployment) was a higher numerical figure.

Descriptive statistics show that, with the exception of the federal minimum wage which remained constant at $7.25 over the two years, all other minimums and maximums increased from 2011 to 2012.

DISCUSSION

Our DEA analysis clearly shows that the expected economic benefits of higher minimum wage and education spending are not shown by the data. The full explanation for this is obviously beyond the scope of this paper. There are many factors which effect income and employment. While education spending and minimum wage are certainly important, they are by no means the only major factors. However, although we recognize the limitations of this analysis, there still is much useful information to be taken from this study.

Specifically, many of the arguments in favor of higher minimum wage and education spending are based on the premise that they will result in increased income and employment. See Hanushek & Woessman (2007), and Neumark & Wascher (2014) as examples. Since those are common arguments made by policymakers and experts, the lack of data to confirm these arguments is significant as a policy matter.

An obvious point to be made here is that there is tremendous variation among the states (as we defined the term here) which are not considered in the data. From a statistical viewpoint, it is hard to correlate the unique economic conditions in the District of Columbia and a state like South Dakota. However, while we know that there will be outliers when comparing the data, our results still show overwhelmingly that there is simply no provable correlation to prove the initial hypotheses. In each instance, the Group 2 states (lower minimum wage, lower education spending) clearly performed better. The data did not show a large group of states affirming the hypotheses with a few outliers in opposition. Even in the case of states that have much more comparable characteristics, the hypotheses were proven wrong. One potential factor that could have an influence on the results might be individual income tax. For example, New Hampshire and Florida do not impose a state tax on individual income that is earned from salaries and wages.

CONCLUSION

Our analysis utilized Data Envelopment Analysis (DEA) to test whether the economic policies of a U.S. state (including D.C.) regarding minimum wage and per pupil education spending (the Inputs) are associated with higher per capita income and higher employment (the Outputs). Our hypotheses, which match the policy arguments that are made in favor increasing these Inputs, were that there would be a positive correlation.

As discussed above, there are numerous articles and studies on these topics. All states would consider higher per capita income and higher employment to be major goals. Education spending and minimum wage happen to be some of the few economic factors over which states have some degree of control. Many of the arguments for and against increases in these Inputs arise in highly contentious political arguments, and there is tremendous risk that the arguments are tainted by the political process and the desire to manipulate data to achieve a desired result.

We also acknowledge that there are obvious issues when comparing states since there is such variation among them in terms of demographics, population density, topography, climate, etc. However, while recognizing that there are enormous differences between particular states, if the initial hypotheses were correct, we would expect to see the positive correlations proven overall, even if there were a few outliers.

Instead, our analysis showed with surprising consistency that there is no positive correlation between these criteria. States with lower minimum wages and lower education spending clearly outperformed their sister states when it comes to income and employment.

The issues addressed in this paper are of tremendous significance to policymakers and the general population. We do not pretend that our analysis will somehow definitely resolve the debates over proper minimum wage and education spending, or their relation to income and employment.

However, this analysis does provide very useful information for policymakers and experts seeing to understand these issues. The results of our data analysis can also be used for more targeted analysis of this type of data. In particular, as we noted above, the correlation between education spending and income or employment is not something that has a direct cause and effect relationship within a one or two-year period. Analysis of this kind of data with a time lag of 20 years or so in particular might be of great benefit.

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Appendix 1 - Sample Data					
DMU	(I) Population 2012	(I) State Employees	(I) State Payroll Total	(O) Employment Rate 2012	(O) Per Capita Income 2012
Alabama	4,816,089	106,121	360,567,485	91.6	23587
Alaska	731,228	30,733	143,696,127	91.8	32537
Arizona	6,553,262	85,445	288,862,096	91.5	25571
Arkansas	2,949,499	74,133	244,671,849	91.7	22007
California	38,056,055	482,955	2,457,564,155	88.7	29551
Colorado	5,191,731	100,780	359,622,278	91.5	31039
Connecticut	3,593,541	77,974	342,263,173	91.4	37807
Delaware	917,099	31,843	113,301,806	92.4	29733
Florida	19,352,021	210,435	719,657,689	91.2	26451
Georgia	9,917,639	161,375	504,186,715	90.3	25309
Hawaii	1,392,641	72,093	235,935,060	93.5	29227
Idaho	1,596,097	28,142	89,881,587	91.5	22581
Illinois	12,875,167	156,362	667,271,954	90.4	29519
Indiana	6,538,283	116,850	354,315,088	91.0	24558
Iowa	3,076,636	66,981	258,203,484	94.0	26545
Kansas	2,886,281	59,406	209,923,024	93.7	26845
Kentucky	4,382,667	102,026	326,289,343	90.9	23210
Louisiana	4,603,676	94,022	334,944,475	92.7	24264
Maine	1,328,888	27,215	86,226,202	91.2	26464
Maryland	5,890,740	91,750	416,851,778	92.7	36056
Massachusetts	6,657,780	121,013	501,048,477	92.8	35485
Michigan	9,886,879	183,804	718,786,790	90.3	25547
Minnesota	5,380,443	101,644	407,615,032	93.5	30656
Mississippi	2,985,660	65,592	207,131,764	90.5	20670
Missouri	6,025,468	100,948	297,856,730	92.1	25546
Montana	1,005,157	26,401	81,493,066	92.8	25002
Nebraska	1,855,973	37,174	121,595,287	95.5	26523
Nevada	2,754,874	33,247	126,038,099	88.0	27003
New Hampshire	1,321,393	25,184	81,850,091	93.9	32758
New Jersey	8,874,893	164,125	842,455,521	90.3	35928
New Mexico	2,084,792	54,296	196,957,330	92.6	23749
New York	19,606,981	276,321	1,357,078,353	90.6	32104
North Carolina	9,747,021	177,290	633,035,884	90.2	25285
North Dakota	702,265	25,177	76,798,932	96.2	28700
Ohio	11,551,783	185,369	646,042,835	91.7	25857
Oklahoma	3,817,679	83,783	248,365,131	94.4	24046
Oregon	3,899,444	81,414	318,688,691	90.2	26702
Pennsylvania	12,772,789	205,993	763,132,567	91.8	28190
Rhode Island	1,052,393	23,961	102,415,447	88.5	30005
South Carolina	4,721,341	91,834	291,630,080	90.1	23906
South Dakota	834,631	19,350	60,914,948	95.0	25570
Tennessee	6,455,469	102,564	335,830,890	91.8	24294
Texas	26,089,741	362,858	1,373,033,407	92.9	25809
Utah	2,856,343	70,243	227,479,921	93.6	23794
Vermont	626,398	18,098	69,000,984	94.4	28846
Virginia	8,193,374	162,981	551,254,076	93.5	33326
Washington	6,897,292	138,526	495,370,332	90.6	30661
West Virginia	1,856,283	48,887	145,381,256	91.7	22482
Wisconsin	5,726,422	105,422	323,080,484	91.8	27426
Wyoming	577,080	15,962	57,238,163	94.0	28858

Appendix 2
SAMPLE DATA GROUPED BY MINIMUM WAGE IN 2012

DMU	(I) Pop. 2012	(I) State Employees	(I) State Payroll	(O) Emp. Rate 2012	(O) PCI 2012	Min Wage	Group
Washington	6897292	138526	495370332	90.6	30661	9.04	2
Oregon	3899444	81414	318688691	90.2	26702	8.8	2
Vermont	626398	18098	69000984	94.4	28846	8.46	2
Connecticut	3593541	77974	342263173	91.4	37807	8.25	2
Illinois	12875167	156362	667271954	90.4	29519	8.25	2
Nevada	2754874	33247	126038099	88	27003	8.25	2
California	38056055	482955	2457564155	88.7	29551	8	2
Massachusetts	6657780	121013	501048477	92.8	35485	8	2
Alaska	731228	30733	143696127	91.8	32537	7.75	2
Ohio	11551783	185369	646042835	91.7	25857	7.7	2
Florida	19352021	210435	719657689	91.2	26451	7.67	2
Arizona	6553262	85445	288862096	91.5	25571	7.65	2
Montana	1005157	26401	81493066	92.8	25002	7.65	2
Colorado	5191731	100780	359622278	91.5	31039	7.64	2
Maine	1328888	27215	86226202	91.2	26464	7.5	2
New Mexico	2084792	54296	196957330	92.6	23749	7.5	2
Michigan	9886879	183804	718786790	90.3	25547	7.4	2
Rhode Island	1052393	23961	102415447	88.5	30005	7.4	2
Alabama	4816089	106121	360567485	91.6	23587	7.25	1
Arkansas	2949499	74133	244671849	91.7	22007	7.25	1
Delaware	917099	31843	113301806	92.4	29733	7.25	1
Georgia	9917639	161375	504186715	90.3	25309	7.25	1
Hawaii	1392641	72093	235935060	93.5	29227	7.25	1
Idaho	1596097	28142	89881587	91.5	22581	7.25	1
Indiana	6538283	116850	354315088	91	24558	7.25	1
Iowa	3076636	66981	258203484	94	26545	7.25	1
Kansas	2886281	59406	209923024	93.7	26845	7.25	1
Kentucky	4382667	102026	326289343	90.9	23210	7.25	1
Louisiana	4603676	94022	334944475	92.7	24264	7.25	1
Maryland	5890740	91750	416851778	92.7	36056	7.25	1
Minnesota	5380443	101644	407615032	93.5	30656	7.25	1
Mississippi	2985660	65592	207131764	90.5	20670	7.25	1
Missouri	6025468	100948	297856730	92.1	25546	7.25	1
Nebraska	1855973	37174	121595287	95.5	26523	7.25	1
New Hampshire	1321393	25184	81850091	93.9	32758	7.25	1
New Jersey	8874893	164125	842455521	90.3	35928	7.25	1
New York	19606981	276321	1357078353	90.6	32104	7.25	1
North Carolina	9747021	177290	633035884	90.2	25285	7.25	1
North Dakota	702265	25177	76798932	96.2	28700	7.25	1
Oklahoma	3817679	83783	248365131	94.4	24046	7.25	1
Pennsylvania	12772789	205993	763132567	91.8	28190	7.25	1
South Carolina	4721341	91834	291630080	90.1	23906	7.25	1
South Dakota	834631	19350	60914948	95	25570	7.25	1
Tennessee	6455469	102564	335830890	91.8	24294	7.25	1
Texas	26089741	362858	1373033407	92.9	25809	7.25	1
Utah	2856343	70243	227479921	93.6	23794	7.25	1
Virginia	8193374	162981	551254076	93.5	33326	7.25	1
West Virginia	1856283	48887	145381256	91.7	22482	7.25	1
Wisconsin	5726422	105422	323080484	91.8	27426	7.25	1
Wyoming	577080	15962	57238163	94	28858	7.25	1

Appendix 3
FULL RESULTS OF BILATERAL DEA MODELS BY MINIMUM WAGE IN 2012

		Bilateral CCR-I		Bilateral BCC-I		Bilateral SBM-C		Bilateral SBM-V	
DMU	Group	Score	Rank	Score	Rank	Score	Rank	Score	Rank
Washington	2	0.12277	41	0.14600	40	0.105941	39	0.13683	39
Oregon	2	0.18813	33	0.19606	37	0.164449	26	0.16445	31
Vermont	2	0.92519	4	0.97684	10	0.879270	3	0.94075	10
Connecticut	2	0.26819	23	1.00000	3	0.198143	23	1.04721	4
Illinois	2	0.10442	42	0.11208	42	0.076891	43	0.08457	42
Nevada	2	0.44946	15	0.48010	17	0.356818	13	0.35682	17
California	2	0.03384	50	0.03644	50	0.023410	50	0.02595	50
Massachusetts	2	0.16219	37	0.76596	14	0.121499	37	0.71462	11
Alaska	2	0.88980	6	1.74941	1	0.595497	7	1.04616	5
Ohio	2	0.08643	45	0.08860	46	0.069951	45	0.06995	46
Florida	2	0.07717	47	0.07954	48	0.058195	47	0.05819	48
Arizona	2	0.19288	31	0.19815	36	0.146274	32	0.14627	36
Montana	2	0.69340	9	0.70237	15	0.578664	9	0.57866	14
Colorado	2	0.17119	36	0.20956	33	0.146036	33	0.19681	29
Maine	2	0.64404	11	0.66381	16	0.529453	10	0.52945	15
New Mexico	2	0.28960	19	0.29398	24	0.257490	17	0.25749	22
Michigan	2	0.08342	46	0.08684	47	0.069058	46	0.06906	47
Rhode Island	2	0.69264	10	0.77936	11	0.584146	8	0.70012	13
Alabama	1	0.18569	35	0.19137	39	0.145541	34	0.14554	37
Arkansas	1	0.27395	21	0.28201	26	0.210385	21	0.21039	27
Delaware	1	0.70402	8	0.76743	13	0.622674	6	0.70860	12
Georgia	1	0.13091	40	0.13686	41	0.095238	40	0.09524	41
Hawaii	1	0.45573	14	0.45756	19	0.331661	15	0.34943	18
Idaho	1	0.74410	7	0.76769	12	0.520609	11	0.52061	16
Indiana	1	0.18773	34	0.19474	38	0.134249	36	0.13425	40
Iowa	1	0.26905	22	0.27020	28	0.236267	18	0.23627	24
Kansas	1	0.32626	16	0.32870	22	0.272292	16	0.27229	21
Kentucky	1	0.20363	28	0.21147	32	0.155402	31	0.15540	35
Louisiana	1	0.20230	29	0.20601	34	0.161461	27	0.16146	32
Maryland	1	0.24656	24	1.00000	3	0.171992	24	1.00239	8
Minnesota	1	0.18923	32	0.28467	25	0.158501	30	0.24642	23
Mississippi	1	0.31936	17	0.33313	21	0.223853	20	0.22385	26
Missouri	1	0.22601	25	0.23166	30	0.159350	28	0.15935	33
Nebraska	1	0.57408	12	1.00000	3	0.446939	12	1.00579	7
New Hampshire	1	0.95734	3	1.00000	3	0.719617	5	1.05265	2
New Jersey	1	0.13734	39	0.37246	20	0.094774	41	0.32596	20
New York	1	0.07289	48	0.10586	44	0.050946	48	0.07999	44
North Carolina	1	0.10415	43	0.10900	43	0.083919	42	0.08392	43
North Dakota	1	0.91559	5	1.00000	3	0.842157	4	1.00944	6
Oklahoma	1	0.27782	20	0.27782	27	0.199401	22	0.19940	28
Pennsylvania	1	0.08836	44	0.09042	45	0.073867	44	0.07387	45
South Carolina	1	0.22583	26	0.23660	29	0.167483	25	0.16748	30
South Dakota	1	1.13994	2	1.00000	3	1.046648	2	1.04756	3
Tennessee	1	0.19980	30	0.20546	35	0.144109	35	0.14411	38
Texas	1	0.04946	49	0.05025	49	0.038785	49	0.03878	49
Utah	1	0.30076	18	0.30333	23	0.234226	19	0.23423	25
Virginia	1	0.14461	38	1.00000	3	0.111159	38	1.00096	9
West Virginia	1	0.46105	13	0.47462	18	0.340832	14	0.34083	19
Wisconsin	1	0.20769	27	0.21357	31	0.158528	29	0.15853	34
Wyoming	1	1.20601	1	1.20975	2	1.139408	1	1.14183	1
Control Group (1) Rank Sum		770		782		787		796	
Test Group (2) Rank Sum		505		493		488		479	
Mann Whitney U Test Statistic		-0.9297		-0.6871		-0.5861		-0.4042	
p-value (one-tailed)		0.0881		0.1229		0.1394		0.1715	

APPENDIX 4
SAMPLE DATA GROUPED BY EDUCATION SPENDING IN 2012

DMU	(I) Pop	(I) State Employees	(I)State Payroll	(O) Emp. Rate	(O) PCI	Edu $ 2012	Group
Alabama	4816089	106121	360567485	91.6	23587	8562.06	1
Alaska	731228	30733	143696127	91.8	32537	17390.40	2
Arizona	6553262	85445	288862096	91.5	25571	7558.92	1
Arkansas	2949499	74133	244671849	91.7	22007	9410.62	1
California	38056055	482955	2457564155	88.7	29551	9182.89	1
Colorado	5191731	100780	359622278	91.5	31039	8547.66	1
Connecticut	3593541	77974	342263173	91.4	37807	16273.65	2
Delaware	917099	31843	113301806	92.4	29733	13864.57	2
Florida	19352021	210435	719657689	91.2	26451	8371.97	1
Georgia	9917639	161375	504186715	90.3	25309	9247.02	1
Hawaii	1392641	72093	235935060	93.5	29227	12053.78	2
Idaho	1596097	28142	89881587	91.5	22581	6658.57	1
Illinois	12875167	156362	667271954	90.4	29519	12015.02	2
Indiana	6538283	116850	354315088	91	24558	9719.10	1
Iowa	3076636	66981	258203484	94	26545	10038.28	1
Kansas	2886281	59406	209923024	93.7	26845	9748.05	1
Kentucky	4382667	102026	326289343	90.9	23210	9391.18	1
Louisiana	4603676	94022	334944475	92.7	24264	11378.51	2
Maine	1328888	27215	86226202	91.2	26464	12189.07	2
Maryland	5890740	91750	416851778	92.7	36056	13608.74	2
Massachusetts	6657780	121013	501048477	92.8	35485	14142.31	2
Michigan	9886879	183804	718786790	90.3	25547	10855.32	2
Minnesota	5380443	101644	407615032	93.5	30656	10795.89	2
Mississippi	2985660	65592	207131764	90.5	20670	8164.24	1
Missouri	6025468	100948	297856730	92.1	25546	9436.02	1
Montana	1005157	26401	81493066	92.8	25002	10464.49	2
Nebraska	1855973	37174	121595287	95.5	26523	11274.84	2
Nevada	2754874	33247	126038099	88	27003	8222.96	1
New Hampshire	1321393	25184	81850091	93.9	32758	13592.55	2
New Jersey	8874893	164125	842455521	90.3	35928	17266.24	2
New Mexico	2084792	54296	196957330	92.6	23749	8899.08	1
New York	19606981	276321	1357078353	90.6	32104	19552.22	2
North Carolina	9747021	177290	633035884	90.2	25285	8200.32	1
North Dakota	702265	25177	76798932	96.2	28700	11679.05	2
Ohio	11551783	185369	646042835	91.7	25857	11203.80	2
Oklahoma	3817679	83783	248365131	94.4	24046	7466.42	1
Oregon	3899444	81414	318688691	90.2	26702	9490.36	1
Pennsylvania	12772789	205993	763132567	91.8	28190	13339.94	2
Rhode Island	1052393	23961	102415447	88.5	30005	14005.09	2
South Carolina	4721341	91834	291630080	90.1	23906	9147.18	1
South Dakota	834631	19350	60914948	95	25570	8446.36	1
Tennessee	6455469	102564	335830890	91.8	24294	8294.44	1
Texas	26089741	362858	1373033407	92.9	25809	8260.66	1
Utah	2856343	70243	227479921	93.6	23794	6206.18	1
Vermont	626398	18098	69000984	94.4	28846	16039.81	2
Virginia	8193374	162981	551254076	93.5	33326	10655.91	2
Washington	6897292	138526	495370332	90.6	30661	9637.48	1
West Virginia	1856283	48887	145381256	91.7	22482	11444.82	2
Wisconsin	5726422	105422	323080484	91.8	27426	11041.66	2
Wyoming	577080	15962	57238163	94	28858	15897.00	2

Appendix 5
FULL RESULTS OF BILATERAL DEA MODELS ON PUPIL EDUCATION SPENDING $ IN 2012

DMU	Group	Edu $	Bi-CCR-I	Bi-BCC-I	Bi-SBM-C	Bi-SBM-V
Wyoming	2	15897.00	1.6323	1.0000	1.30851	1.31589
Vermont	2	16039.81	1.5031	1.0000	1.20033	1.20213
Alaska	2	17390.40	1.4524	1.0000	1.15080	1.17269
North Dakota	2	11679.05	1.3340	1.0000	1.11132	1.13159
New Hampshire	2	13592.55	0.9843	1.0000	0.79757	1.11527
Delaware	2	13864.57	1.0582	1.0000	1.01942	1.07327
Rhode Island	2	14005.09	0.9476	4.1505	0.76007	1.07452
South Dakota	1	8446.36	0.9496	1.0856	0.77302	1.00310
Maine	2	12189.07	0.7359	1.2503	0.67916	1.00761
Hawaii	2	12053.78	0.6850	1.0000	0.39695	1.05327
Connecticut	2	16273.65	0.3669	1.0000	0.25583	1.13127
Nebraska	2	11274.84	0.5399	1.0000	0.50070	1.00584
Maryland	2	13608.74	0.2974	1.0000	0.19174	1.08975
Montana	2	10464.49	0.8119	0.8303	0.75278	0.75278
Idaho	1	6658.57	0.6199	0.6368	0.45275	0.45275
Massachusetts	2	14142.31	0.2219	1.0000	0.15549	1.07486
Minnesota	2	10795.89	0.2282	1.0000	0.17834	1.00947
Nevada	1	8222.96	0.4495	0.4801	0.35682	0.35682
West Virginia	2	11444.82	0.4340	0.4496	0.38786	0.38786
New Mexico	1	8899.08	0.2896	0.2940	0.25749	0.25749
New Jersey	2	17266.24	0.1657	1.0000	0.10744	1.07301
Kansas	1	9748.05	0.2718	0.2727	0.23780	0.23780
Virginia	2	10655.91	0.1547	1.0000	0.12378	1.04713
Wisconsin	2	11041.66	0.2022	0.4889	0.17549	0.44577
Mississippi	1	8164.24	0.2660	0.2763	0.19522	0.19522
Utah	1	6206.18	0.2505	0.2516	0.20474	0.20474
Iowa	1	10038.28	0.2383	0.2383	0.20684	0.20684
New York	2	19552.22	0.0879	1.0000	0.05690	1.01687
Oklahoma	1	7466.42	0.2314	0.2448	0.17370	0.18567
Arkansas	1	9410.62	0.2282	0.2339	0.18402	0.18402
Louisiana	2	11378.51	0.2008	0.2058	0.18248	0.18248
Illinois	2	12015.02	0.1429	0.4836	0.09732	0.40321
Colorado	1	8547.66	0.1712	0.2096	0.14604	0.19681
Arizona	1	7558.92	0.1929	0.1982	0.14627	0.14627
Oregon	1	9490.36	0.1881	0.1961	0.16445	0.16445
South Carolina	1	9147.18	0.1881	0.1963	0.14584	0.14584
Missouri	1	9436.02	0.1883	0.1922	0.13830	0.13830
Pennsylvania	2	13339.94	0.1036	0.2743	0.08208	0.25767
Kentucky	1	9391.18	0.1696	0.1754	0.13569	0.13569
Tennessee	1	8294.44	0.1664	0.1704	0.12522	0.12522
Alabama	1	8562.06	0.1547	0.1587	0.12712	0.12712
Indiana	1	9719.10	0.1564	0.1615	0.11667	0.11667
Washington	1	9637.48	0.1228	0.1460	0.10594	0.13683
Ohio	2	11203.80	0.1056	0.1194	0.08920	0.11080
Georgia	1	9247.02	0.1091	0.1135	0.08271	0.08271
Michigan	2	10855.32	0.1052	0.1053	0.08912	0.08912
North Carolina	1	8200.32	0.0868	0.0904	0.07317	0.07317
Florida	1	8371.97	0.0772	0.0795	0.05819	0.05819
Texas	1	8260.66	0.0435	0.0440	0.03374	0.03374
California	1	9182.89	0.0338	0.0364	0.02341	0.02595
Control Group (1) Rank Sum			758	870	751	889
Test Group (2) Rank Sum			517	405	524	386
Mann Whitney U Test statistics			2.3380	4.5111	2.2022	4.8798
p value (one tailed)			0.0048	0.0000	0.0069	0.0000

Appendix 6
STATE RANKINGS FROM DEA MODELS ON PUPIL EDUCATION SPENDING

DMU	Group	Bi-CCR-I	Bi-BCC-I	Bi-SBM-C	Bi-SBM-V	Rank Sum	Total Rank
Wyoming	2	1	4	1	1	7	1
Vermont	2	2	4	2	2	10	2
Alaska	2	3	4	3	3	13	3
North Dakota	2	4	4	4	4	16	4
New Hampshire	2	6	4	6	6	22	5
Delaware	2	5	4	5	10	24	6
Rhode Island	2	8	1	8	9	26	7
South Dakota	1	7	3	7	18	35	8
Maine	2	10	2	10	16	38	9
Hawaii	2	11	4	13	12	40	10
Connecticut	2	16	4	17	5	42	11
Nebraska	2	13	4	11	17	45	12
Maryland	2	17	4	22	7	50	13
Montana	2	9	19	9	19	56	14
Idaho	1	12	20	12	20	64	15
Massachusetts	2	26	4	29	8	67	16
Minnesota	2	24	4	25	15	68	17
Nevada	1	14	23	15	24	76	18
West Virginia	2	15	24	14	23	76	19
New Mexico	1	18	25	16	26	85	20
New Jersey	2	36	4	39	11	90	21
Kansas	1	19	28	18	27	92	22
Virginia	2	38	4	37	13	92	23
Wisconsin	2	27	21	26	21	95	24
Mississippi	1	20	26	21	31	98	25
Utah	1	21	29	20	29	99	26
Iowa	1	22	31	19	28	100	27
New York	2	46	4	48	14	112	28
Oklahoma	1	23	30	27	32	112	29
Arkansas	1	25	32	23	33	113	30
Louisiana	2	28	34	24	34	120	31
Illinois	2	40	22	41	22	125	32
Colorado	1	33	33	31	30	127	33
Arizona	1	29	35	30	36	130	34
Oregon	1	31	37	28	35	131	35
South Carolina	1	32	36	32	37	137	36
Missouri	1	30	38	33	38	139	37
Pennsylvania	2	45	27	45	25	142	38
Kentucky	1	34	39	34	40	147	39
Tennessee	1	35	40	36	42	153	40
Alabama	1	39	42	35	41	157	41
Indiana	1	37	41	38	43	159	42
Washington	1	41	43	40	39	163	43
Ohio	2	43	44	42	44	173	44
Georgia	1	42	45	44	46	177	45
Michigan	2	44	46	43	45	178	46
North Carolina	1	47	47	46	47	187	47
Florida	1	48	48	47	48	191	48
Texas	1	49	49	49	49	196	49
California	1	50	50	50	50	200	50