A Subsidy to the States:

Determining the Value of the Implied Federal Guarantee on US State Debt

by

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Abstract

The global financial crisis of 2008 and 2009 has called into question the fiscal sustainability and solvency of several US state governments. As more of these states approach insolvency, discussion of a federal bailout has increased. As a result, we develop and use a model that accurately forecasts sovereign credit ratings and apply it to the fifty states to determine a stand alone credit rating and spread. Using this stand alone spread, we are able to calculate the approximate subsidy being given to each US state by the federal government (in the form of cheaper credit) and apply the subsidy to US debt to get a sense of the true costs of these subsidies.

[1] I am eternally grateful to Professor Sundaram. Without his patience, advice, and insight, I would not have been able to complete this paper. His ability to take my rambling and, at times, disjointed thoughts and focus them on a specific issue gave me the ability to finish this work. Further, I owe thanks to the entire Stern School of Business and, in particular, Professor Subrahmanyam for his continued support for the honors program. I would like to congratulate and thank the entire Stern Honors Class of 2011, without whose assistance, encouragement, and light-heartedness I would not have been able to complete this project. Finally, I am indebted to my family (Mom, Dad, Haley, and Abby) for their love and support throughout the last four years.

1. Introduction

In the wake of the global financial crisis, US state and local governments' ability to honors their debt obligations has been called into question. Some, notably California, Illinois, New York and Michigan, have been compared to the debt-ravaged euro-zone countries of Greece and Portugal.[2] Despite increased negative press and attention on the deteriorating financial situation of US states, Moody's and S&P continue to rate all states at investment grade, and the market continues to value their debt at a level commiserate with their ratings. With the notable exception of California and Illinois, all states maintain at least a AA-ratings from S&P and continue to enjoy considerably low borrowing costs.

While determining the ability of a US state government to repay its debt obligations is no easy task, the fact that these states continue to enjoy borrowing costs at low rates raises the specter of Fannie Mae and Freddie Mac. In 2001, the CBO estimated that the subsidy provided to Fannie and Freddie as a result of their "special" status (as Government Sponsored Entities) was 41 basis points. Despite the fact that there was no explicit guarantee from the federal government on the debt issued by these two GSEs, the market continued to price Fannie and Freddie's debt below other AAA-rated corporations due to the implied federal guarantee.[3] Ultimately, the market was correct in assuming a federal guarantee and the federal government bailed-out these two GSEs.[4]

The US states are in a similar predicament. The recent financial crisis has placed tremendous downward pressure on state revenues in addition to increased pension plan underfunding due to decreased asset values. Further, going forward, states will likely be forced

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[2] "Public Finances: Can pay, won't pay" The Economist June 17, 2010

[3] CBO Testimony of Dan L. Crippen. "Federal Subsidies for the Housing GSEs" May 23, 2001 <http://www.cbo.gov/doc.cfm?index=2839&type=0>

4 Andrews, Edmund "U.S. takes control of Fannie Mae and Freddie Mac" The New York Times September 7, 2008

to become less reliant on the federal government for transfer payments as politicians focus on deficit reduction. Recently, the GAO predicted that the states will face a $9.9 trillion "fiscal gap" between 2009 and 2058 (roughly 70% of current GDP). This fiscal gap results from a perfect storm of the loss of stimulus money, expiring tax increases, elimination of one-time revenue sources (such as securitization of future expected revenues), and increased reliance on the state as the population continues to age.[5] Despite these pressures, all states continue to enjoy the same borrowing privileges as Fannie and Freddie prior to government intervention.

This paper examines this phenomenon and attempts to put a value on the federal subsidy to the states. This value has obvious and important implications for the federal government. While not accounted for in either its on balance sheet or off-balance sheet liabilities, the subsidy represents the approximate present value of state liabilities the federal government is currently implicitly guaranteeing. Similar to what occurred during the global financial crisis with Freddie and Fannie, the federal government, despite previous statements to the contrary, could not stomach letting these institutions fail. Should the same occur with US state government debt, the federal government will be liable for the debt on state balance sheets.

In order to value this subsidy, this paper will first determine what the appropriate credit rating for each state would be in the absence of a guarantee and use these ratings as a proxy for what the state's stand alone credit spread should be. We do this by developing a model for sovereign credit ratings and applying it to each US state. We find that every state, with the exception of California, is currently over-rated and receiving some subsidy from the US Government. While no state receives stand-alone credit ratings below investment grade, three

[5] Norcross, Eileen "State and Municipal Debt: The Coming Crisis?" Testimony Before the House Committee on Oversight and Government Reform. February 9, 2011

states (Connecticut, Delaware, and Illinois) do receive BBB+ ratings, the lowest investment grade rating group available.

Using the difference between the stand alone credit spread calculated based on the model and the 'real' spread the states are currently borrowing at, we calculate the subsidy that was given to each state over the past four years (2007, 2008, 2009, and 2010) on debt issued in those years. We use three different methods to determine that the subsidy ranges from $717 million to $74 billion depending on the methodology employed. Finally, we add this to the US Federal debt in order to determine what the true impact of this credit subsidy when the present value of these implied guarantees are properly accounted for.

This paper proceeds with the following sections. Section 2 discusses the method for determining the stand alone credit ratings of each of the US states. Section 3 discusses the data used. Section 4 presents the results of the model presented in section two. Section 5 discusses the three methods for valuing the subsidy. Section 6 applies each method and reports the results. Finally, section 7 concludes.

2. Credit Rating Methodology

There has been relatively little work on explaining the determinants of US state credit ratings. However, there has been quite a bit of work on modeling sovereign credit ratings using observable macroeconomic data in recent years in addition to some work on determining subsovereign credit ratings for non-US subsovereigns, again using observable macroeconomic data.

Most models of sovereign credit ratings use Moody's, S&P or an average of the two as their dependent variable. Ratha, De, and Mohapatra (2007) provide a summary of previous models of determinants of sovereign credit ratings. Across eight studies sampled by Ratha et al,

all use macro-level data on the sovereign countries in determining their ratings. Most popular and significant in the models over the studies were GDP per capita, GDP Growth, inflation, and various debt ratios.[6] Furthering the support for these sovereign findings at the sub-sovereign level, Gaillard (2009) shows that GDP per capita and direct debt to operating revenue, along with sovereign default history, explains over 80% of the variation in non-US subsovereign credit ratings.[7]

The purpose of developing our model for the determinants of sovereign credit ratings is to apply said model to the US states. As such, we will be assuming that US states and their respective stand alone ratings act similarly to sovereign ratings. Given the size and operation of most US states, this assumption is reasonable; however, the key exception is the lack of monetary policy control that states have. As such, developing a model of sovereign credit ratings will only include factors that can be equivalently found for the states. While this somewhat restricts the number of variables within our model and the potential explanatory power of said model, the results below are robust enough that the exclusion of monetary policy variables is not a significant concern. Further, previous analysis has excluded these same monetary policy variables and discovered robust results (Cantor and Packer, 1996). Therefore, while excluding these variables restricts the explanatory power of the model, it is not without precedent.

While excluding monetary policy variables, there are still innumerable factors that contribute to the credit quality of a sovereign. In order to capture the most appropriate ones that can be scaled to a subsovereign, we consider the results of previous studies surveyed by Ratha et al in addition to the consideration S&P gives to various factors when determining a sovereign's

[6] Ratha, Dilip, Prabal De and Sanket Mohapatra. "Shadow Sovereign Ratings For Unrated Developing Countries" *Development Prospects Group – The World Bank*. April 20, 2007
[7] Gaillard, Norbert "Determinants of Moody's and S&P's Subsovereign Credit Ratings"

credit rating. This method has been followed by most of the literature and found to be highly successful in producing results that explain a large percentage of the variation in credit ratings (Cantor and Packer, 1996). S&P breaks down their framework for rating sovereigns into nine broad categories of risks. These risk factors measure both qualitative and quantitative risks associated with sovereign debt securities.

Further, S&P rates most sovereign's foreign-currency and domestic-currency debt separately. The key distinction between the two, normally, is their denomination in foreign currency (US Dollars, Euros, or Yen) versus domestic currency. With no known exceptions, foreign currency is always rated lower or at the same level as domestic currency debt. While monetary flexibility allows countries to print money in order to pay off its domestic currency debt, foreign currency debt forces states to go into the market and purchase currency. According to S&P, "this [purchasing foreign exchange in the currency markets] can be a binding constraint, as reflected in the much higher frequency of sovereign foreign than local currency debt defaults."[8] As a result, our model only considers these foreign currency debt ratings.

Additionally, the credit ratings of S&P need to be transformed in order to make them appropriate variables for use in a regression model. Past practice in sovereign credit rating models transforms each rating into an ordinal numeric variable with an equal interval between each credit rating. Despite the fact that there is significant differences between some credit ratings that are only one notch away (most notably the difference between Investment Grade, BBB-, and non-Investment Grade, BB+), our model conforms to the previous adopted standards of Cantor and Packer (1996), Ferri, Lui and Stigliz (1999), and numerous others. The transformation methodology adopted here changes AAA into a 1, AA+ into a 2, and so on.[9]

[8] Sovereign Credit Ratings: A Primer. Published May 19, 2008 by Standards & Poors
[9] Please see appendix for full transformation table

Table 1: S&P Sovereign Ratings Framework	
Risk Factor	**Examples**
Political Risk	• Stability of political institutions • Enforcement of contracts • Public security
Income and Economic Structure	• Income inequality • Labor flexibility • Competitiveness of private sector
Economic Growth Prospects	• Predicted/expected rate of economic growth
Fiscal Flexibility	• Central government revenue, expenses and surplus/deficit trends • Ability to raise revenue • Expense flexibility
General Government Debt Burden	• Central government debt to GDP • Amount of revenue devoted to paying interest on debt
Offshore and contingent liabilities	• Public pension plans • Entitlement programs
Monetary Flexibility	• Price behavior • Inflationary pressures • Effectiveness of monetary policy and monetary institutions
External Liquidity	• Structure of the current account • Reserve adequacy
External Debt Burden	• Maturity profile of debt • Debt service burden

Using S&P's risk framework for sovereigns (see Table 1) in conjunction with previous research on the topic of modeling sovereign credit ratings based on determinants of sovereign credit risk, we establish quantitative proxies for each of S&P's risk factors. We exclude political risk and monetary flexibility from these quantitative proxies. Political risk is excluded due to the fact that political risk is difficult to quantify and US states exhibit similar political factors compared to sovereign governments (that is, public security or political institutions, though they vary across the US, have relatively little variation when compared to sovereign governments across the world.) Monetary flexibility is excluded based on the non-existent monetary flexibility among the US states. Further, while monetary flexibility is an important factor in

local currency debt, the monetary flexibility of a sovereign should have relatively little impact on foreign exchange markets and the ability of said sovereign to pay off foreign currency debt. With the seven remaining risk factors, we develop quantitative proxies for each. The proxy variables can be found in Table 2 and their applicability is discussed below.

Table 2: Model Variables Based on S&P Sovereign Risk Factors

Risk Factor	Variables
Political Risk	• N/A
Income and Economic Structure	• GDP Per Capita • GNI Per Capita • Long-term unemployment • Consumer Price Inflation • Government spending to GDP
Economic Growth Prospects	• Projected GDP Growth • Population Growth
Fiscal Flexibility	• Budget deficit to Government Revenues
General Government Debt Burden	• Central Government Debt to GDP • Central Government Debt per capita • Central Government Debt to Income per capita
Offshore and contingent liabilities	• Compensation of employees to expenses
Monetary Flexibility	• N/A
External Liquidity	• Debt Service Payments to Tax Revenue • Debt service to GDP • Debt service per capita • Debt service per capita to Income per capita
External Debt Burden	• See General Government Debt Burden variables

Income and Economic Structure Variables:

- GDP Per Capita: As a measure of income and economic structure, GDP per capita is able to capture both the wealth of the nation with respect to its size and the development of its economy, as the higher the GDP per capita the further

developed the economy of the sovereign would be. This variable is expected to have a negative correlation with the credit rating.[10]

- GNI Per Capita: This measure represents a direct measure of the sovereign's income with respect to its size. As such, this variable captures a measure of income, economic structure, and the ability of the state to repay its obligations as a state with higher GNI per capita is able to take on more debt because it can extract more in revenue from a people with a higher income. This variable is expected to have a negative correlation with the credit rating.
- Long-term Unemployment: This measure primarily is a proxy for a country's economic structure as higher long-term unemployment would represent an underdeveloped economy that cannot sufficiently employ its people. This variable is expected to have a positive correlation with the credit rating.
- Consumer Price Inflation: Inflation represents a measure of a country's economic stability and the strength of its economic system. Higher inflation would be associated most with less stable countries that have weaker economic institutions (based on their lack of ability to curb higher inflation.) As such, this variable is expected to have a positive correlation with the credit rating
- Government Spending to GDP: Government spending, as a percentage of GDP, represents the government's involvement in the economy. The largest this involvement is, the more GDP growth is determined by the state's spending and not by the productivity of its citizens. As a result, the higher this percentage is, the less growth is expected in a given state. This should cause the credit rating to

[10] Due to the transformation of the sovereign credit ratings, as the dependent variable (in numeric form) increases, credit quality decreases. As such, variables that signal increased credit quality as they increase are expected to be negatively correlated with the numeric representation of the credit rating and vice versa

worsen and, as such, government spending to GDP is expected to be positively correlated with credit ratings.

Economic Growth Prospects Variables:

- Projected GDP Growth: One of the best measures of a country's growth prospects is its expected GDP Growth in the coming years. While there are obvious qualitative measures that go into determining a countries future growth prospects, expected GDP Growth is an adequate measure, as a country with larger expected GDP growth is, all things equal, more likely to grow its economy in the future. This variable is expected to be negatively correlated with the credit rating.
- Population Growth: Understanding whether or not a country's population will grow provides some insight into what that countries growth prospects look like in the future. However, it is not clear how this variable should be correlated with credit ratings. An increase in the population contributes to an increase in the productive working age population in the future, which should raise the prospects of the country (and by extension, its credit rating.) However, in underdeveloped countries, increased populations mean more people drawing on smaller pools of resources as there are no productive opportunities for these individuals. With every extra mouth to feed comes another pair of hands to be put to productive use. This essential conundrum results in this variables direction being ambiguous.

Fiscal Flexibility Variables:

- Budget Deficit to Government Revenue: Fiscal flexibility is a measure of a government's ability to change its fiscal policy (on either the revenue or expense side) in order to promote sustainable economic growth. As such, high deficits

relative to the revenue taken in by the central government generally reflect two things. First, increasing revenue to make up for the shortfall will be increasingly difficult the higher the ratio and could impact future economic growth. Second, cutting the expense side of the budget will limit the government's spending in the future, which could also negatively impact growth. Further, large deficits, especially relative to revenue, turn into central government debt that will, in the future, take more and more revenue to support (in the form of interest payments). Therefore, this variable is expected to be negatively correlated.[11]

General Government Debt Burden Variables:

- Central Government Debt to GDP/Central Government Debt per capita/Central Government Debt to Income per capita: All three of these measures represent different approaches to measure the amount of debt each sovereign currently has on its balance sheet. Obviously, due to the difference size of a country's economy, these all need to be relative measures of debt. Just as with corporates, the larger the government debt burden the more likely the sovereign is to default on the debt. As such, these variables are expected to be positively correlated with credit ratings.

Off shore and contingent Variables:

- Compensation of Employees to Expenses: Compensation of Employees includes two aspects of public financing. First, the actual year-to-year salary for government employees. Second, the year-to-year budgetary costs of the nation's pension programs (which is why this variable is listed under off-balance sheet

[11] Budget deficits in the proceeding model are represented by negative numbers. Since the credit rating numeral increases as credit quality deteriorates larger deficits (negative) should produce a larger credit rating numeral, making the regression coefficient and the correlation negative.

obligations.) The year-to-year costs of pension programs serves as a proxy for the total liability the pension represents. Secondly, these figures are also a good proxy for non-discretionary spending that would be difficult to trim from the budget. As such, the higher this proportion is, the more a country spends on programs that will be difficult to eliminate (or, at least would be politically difficult.) With this in mind, this variable is expected to be positively correlated with credit ratings.

External Liquidity Variables:

- Debt Service Payments to Tax Revenues/Debt Service Payments to GDP/Debt Service Payments per capita/Debt Service Payments to per capita income: Another consequence of debt is the fact that debt service eats up a portion of tax revenues. As these ratios increase, a country either must decrease government spending, raise revenues to keep government spending constant while continuing to service debt, or increase the amount of debt the country issues. All three will, ultimately, have negative repercussions on the nation's economic growth prospects. As a result, these variables should be positively correlated with credit ratings.

In order to test the impact these variables have on sovereign credit ratings, two types of regression analysis were performed. The first performed was an Ordinary Least Squared (OLS) regression following the tradition of Cantor and Parker (1996) and Sutton (2005). Our model takes on the following form:

$$\textit{Sovereign Rating (AAA = 1, AA = 2,….C- = 23)} = \alpha + \beta_1\textit{(GDP per capita)} + \beta_2\textit{(GNI per capita)} + \beta_3\textit{(Long term unemployment)} + \ldots \beta_{15}\textit{(Debt service per capita to Income per capita)} + \varepsilon$$

The OLS regression model coefficients will be used to extrapolate the stand alone state credit ratings. However, the most appropriate model to use when dealing with a dependent variable that is ordered and nominal in nature is a multinomial ordered probit model. This model produces the probability of a rating falling into one of the categories given the variables described above. The results of this model provide support for the results in the OLS regression; however, keeping with previous literature on extrapolating non-rated sovereigns from sovereign data (Ratha et al.) this paper uses the OLS regression coefficients to determine the model-predicted ratings of the US states. Using the same model advanced by Gaillard (2006), our dependent variable, Y, (S&P Sovereign Credit Ratings) is represented by a linear function containing the set of explanatory variables, X, with a parameter vector of β and a random error term ε such that: $Y = \beta x + \varepsilon$. Y is recorded in the following arrangement:

$y = AAA \quad \text{if } Y \leq \mu_1$
$y = AA+ \quad \text{if } \mu_1 < Y \leq \mu_2$
…
$y = C- \quad \text{if } \mu_{22} < Y \leq \mu_{23}$

Given that the normal distribution's cumulative function is denoted by ϕ, we obtain the following:

$P(y = AAA = 1) = \phi(\mu_1 + \beta x)$
$P(y = AA+ = 2) = \phi(\mu_2 + \beta x) - \phi(\mu_1 + \beta x)$
$P(y = AA = 3) = \phi(\mu_3 + \beta x) - \phi(\mu_2 + \beta x) - \phi(\mu_1 + \beta x)$
…
$P(y = C+ = 23) = 1 - \phi(\mu_{23} + \beta x)$

3. Data – Sovereign Credit Ratings Model

As in previous studies of sovereign credit ratings, cross-sectional time series data is used in both of the regressions. The data consists of all countries for which any S&P sovereign rating is available from 1993 to 2009. Because ratings fluctuate from year to year, the sovereign credit rating at the end of the year (on December 31st of that year) is recorded as the rating for that year. That is, if a country started out 1999 with a AA rating and was downgraded to AA- in September and further downgrade to A+ in November, the rating for that country in 1999 is represented by the numerical equivalent of an A+ rating. This data is available for 115 countries with ratings ranging from AAA to C which includes 1484 observation.[12]

The independent variables, with the exception of the GDP growth prospects and population growth prospects, represent the values for those variables in the year preceding the rating (that is, for the hypothetical country discussed, 1998 data.) The data is lagged in this way due to the nature of incoming macroeconomic data. The assumption in this model, with the way the data is lagged, is that credit rating agencies (and the broader market interested in purchasing sovereign debt) looking to rate a country in 1999 use 1998 data due to the fact that 1999 data does not yet exist. While it is possible to extrapolate some hypothetical values for the 1999 data from the 1998 data, our assumption stands that, since they cannot view the real data, it is inappropriate to use those values for that year. However, when the regression is re-run without this lag, there is little difference in the results produced.

All of the independent variables come from the World Bank's World Development indicators with the exception of the projected GDP growth which comes from the April edition

[12] Fewer observations are included in the following regressions due to unavailable consistent data for some of the countries included.

of the IMF's World Economic Outlook reports.[13] Due to the number of variables in the model discussed above and the variability in available data on countries from the World Bank and the IMF, the final regression model contains 250 observations from the period 1993 to 2009.[14]

4. Results – Sovereign Credit Ratings Model

Results from both models (OLS and multinomial ordered probit) along with the expected direction of the coefficient can be found in Table 3.

The results of the two regression models produce similar findings. In each the independent variables GNI per capita, long-term unemployment, consumer price inflation, budget deficit to government revenues, central government debt per capita, and compensation of employees are found to be statistically significant at the 0.05 level and in the expected direction as discussed above. When controlling for the ordered and nominal nature of the dependent variable, the pseudo-R-squared does decreases; nevertheless, the results in the multinomial ordered probit analysis are consistent with what is found in the OLS regression. Further, given that the OLS regression accounts for close to three-fourths of the variation in the data and the statistical significance of several of the independent variables, it can be concluded that the model is robust and, more importantly, can be appropriately applied to the US states.

[13] The projected GDP growth represents the IMF's expectation of GDP growth in the coming year
[14] Summary statistics for the independent variables can be found in the appendix

Table 3: Regression Results

Variables	Expected Sign	OLS	MOP
GNI Per Capita	-	**-0.000127**	**-0.000242**
		(-2.68)	**(-3.06)**
Long-term Unemployment	+	**0.0270111**	**0.0233401**
		(2.92)	**(2.77)**
GDP Per Capita	-	0.0000695	0.0000817
		(-1.88)	(1.19)
Consumer Price Inflation	+	**0.4660993**	**0.2652855**
		(8.07)	**(5.74)**
Projected GDP Growth	-	0.2009612	0.0256503
		(1.77)	(0.27)
Population Growth	Mixed	**-1.375422**	-0.304877
		(-5.84)	(-1.44)
Budget Deficit to Government Revenues	-	**-2.225092**	**-2.409931**
		(-2.66)	**(-2.78)**
Central Government Debt to GDP	+	-0.056406	-0.014885
		(-1.95)	(-0.54)
Central Government Debt Per Capita	+	**1.53E-06**	**1.53E-06**
		(3.64)	**(3.24)**
Central Government Debt Per Capita to Income Per Capita	+	0.0032901	-0.032115
		(0.12)	(-1.30)
Debt Service Payments to Tax Revenue	+	0.2056776	0.1586167
		(1.65)	(1.58)
Compensation of Government Employees to Expenses	+	**0.1326455**	**0.0832159**
		(7.36)	**(5.66)**
Debt Service to GDP	+	0.0073402	0.0002237
		(1.19)	(0.04)
Debt Service Per Capita	+	-2.42E-07	1.89E-08
		(-1.79)	(1.19)
Debt Service to Tax Revenue	+	-6.77E-11	-5.83E-11
		(-3.39)	(-2.82)
Government Spending to GDP	+	-0.073194	-0.044753
		(-2.58)	(-1.42)
Constant		2.211618	
		(1.78)	
N-Size		250	250
Adjusted R-squared		71.97%	37.69%

Note: Coefficients in bold are statistically significant at the 0.05 level and in the anticipated direction

In applying the OLS Regression model to the US States, a few assumptions must be made. First, it is assumed that the model is robust and is predictive. Based on the results of both the OLS regression and the multinomial ordered probit analysis, this assumption seems reasonable. Second, for the purpose of this analysis, the assumption must be made that the stand alone US states' credit ratings follow this general pattern. In looking at how S&P determines credit ratings for the US states, they look at five factors presented in Table 4.

Table 4: S&P US State Ratings Framework[15]

Risk Factor	Examples
Government framework	• Fiscal policy framework • System support
Financial management	• Budget management • Appropriate economic estimates and forecasts • Liquidity profile
Economy	• Wealth and income • Economic development prospects
Budgetary performance	• Tax and revenue structure • Budget reserves • Budget management
Debt and liability profile	• Debt burden • Pension liabilities

The framework that S&P uses to rate US states does not differ much from that used for its sovereign ratings framework. Where it does differ, it does not include variables that would generally be considered in the 'political risk' and 'monetary flexibility' section of the sovereign ratings framework. Due to the nature of the US states, these variables were excluded from the independent variables chosen; therefore, the model above contains variables that would also be used in rating a US state. Second, US states are large governmental entities that have the power to issue debt that is only backed by the faith and credit of that state's government (in addition to

[15] Wiemken, Jim, Robin Prunty, and Horacio Aldrete. "US State Rating Methodology" Presentation dated January 5, 2011. <http://www2.standardandpoors.com/spf/pdf/events/PFTcon1511Slides.pdf>

their ability to tax.)[16] California, by example, would be the eighth largest economy in the world if it were a sovereign nation.[17] Further, while there is sizable variability between the economic size of each US state, even Vermont, which according the US Bureau of Economic Analysis has the smallest GSP at roughly $25 billion, would still make the top 100 list in terms of size of its economy if it were a sovereign nation. Lastly, US states provide a variety of services to their citizens including health care, education, and public safety. In several other sovereign governments included in the initial model, these public goods are provided by the central government.

While the US states do receive transfer payments from the federal government, almost half of US state revenues come from local state taxes (and most intergovernmental transfers are for selected services, namely Medicaid and Medicare.)[18] Further, as federal politicians concentrate on deficit reduction, the states will come to rely more heavily on local revenues, which will create circumstances that are even more sovereign-like than the present situation.

With the previously stated assumptions given, the coefficients produced by the OLS regression are multiplied by the independent variable for each of the fifty US states. The data for the US states is from one year prior (2009) and comes from two sources: the US Census bureau and the US Bureau of Economic Analysis. Once each variable is multiplied by the appropriate coefficient, those values are summed on an individual state basis to produce a numeric value serving as a proxy for stand alone credit quality or the stand alone credit rating. In order to transform these numeric values ($\hat{Y}$) into credit ratings, the following procedure is utilized:

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[16] Twelve states do not have the power to issue General Obligation debt. They are: Arizona, Colorado, Idaho, Indiana, Iowa, Kansas, Kentucky, Nebraska, North Carolina, North Dakota, South Dakota, and Wyoming. They are included in the analysis that follows, but excluded from calculating a subsidy as only general obligation debt is included in that calculation.

[17] "Calif. retains economy that would be 8th largest" Bloomberg Businessweek December 2, 2010 <http://www.businessweek.com/ap/financialnews/D9JS1MLO0.htm>

[18] 2009 Annual Survey of State Government Finances. US Census Bureau

Rating = AAA; if $\hat{Y} \leq 1$

Rating = AA+; if $1 \leq \hat{Y} \leq 2$

Rating = AA; if $2 \leq \hat{Y} \leq 3$

…

Using this transformation process, each state's stand alone credit rating, with the exception of California, is lower than currently rated by S&P. Table 5 contains the list of states with their stand alone credit rating, as predicted by the model, and the 'real' credit rating that S&P currently has them rated at.

Table 5: US State 'True' Credit Ratings

State	Stand Alone Rating	'Real' Rating	Difference	State	Stand Alone Rating	'Real' Rating	Difference
Alabama	A+	AA	2	Montana	AA-	AA	1
Alaska	A-	AA+	5	Nebraska	A	AA+	1
Arizona	A	AA-	1	Nevada	A-	AA+	2
Arkansas	A+	AA	2	New Hampshire	A	AA	3
California	A-	A-	0	New Jersey	A-	AA	4
Colorado	A-	AA	4	New Mexico	A+	AA+	3
Connecticut	BBB+	AA	5	New York	A-	AA	4
Delaware	BBB+	AAA	7	North Carolina	A	AAA	5
Florida	A	AAA	5	North Dakota	A	AA+	4
Georgia	A	AAA	5	Ohio	A	AA+	4
Hawaii	A	AA	3	Oklahoma	A	AA+	4
Idaho	A+	AA	2	Oregon	A-	AA	4
Illinois	BBB+	A+	3	Pennsylvania	A	AA	3
Indiana	A+	AAA	4	Rhode Island	A-	AA	4
Iowa	A	AAA	5	South Carolina	A+	AA+	3
Kansas	A	AA+	4	South Dakota	A	AA	3
Kentucky	A+	AA-	1	Tennessee	A	AA+	4
Louisiana	A	AA-	2	Texas	A	AA+	4
Maine	A+	AA	2	Utah	A	AAA	5
Maryland	A	AAA	5	Vermont	A+	AA+	3
Massachusetts	A-	AA	4	Virginia	A-	AAA	6
Michigan	A+	AA-	1	Washington	A-	AA+	5
Minnesota	A	AAA	5	West Virginia	AA-	AA	1
Mississippi	AA-	AA	1	Wisconsin	A-	AA	4
Missouri	A	AAA	5	Wyoming	A-	AA+	5

Three states, Connecticut, Delaware, and Illinois, drop to BBB+ status while the rest of the states, though they all are notched down (California excluded), remain in at least the single-A range. In terms of expectations, as set by the press, some of the results are not surprising at all while others are somewhat puzzling. It comes as no shock that Connecticut and Illinois' stand alone credit rating should be BBB+ (some may argue it should be lower.) However, unlike Connecticut and Illinois, which represent the epitome of poor fiscal management, at least in the financial press, Delaware is hardly spoken about. Further, the largest 'jumps' in notches tend to occur for states that are very highly rated (AAA or AA+) while states that are relatively low-rated (e.g. California) are only notched down slightly. This observation points out that S&P could be more concerned with or pays more attention to large states (e.g. California, Illinois, Connecticut, New Jersey, etc…) which means they will face more scrutiny and their 'real' ratings should be more aligned with their predicted stand alone ratings. Second, S&P could also be pricing in the implied federal guarantee of US State debt, and, as such, small states with relatively smaller debt (in real terms) are more likely to be bailed out than a larger state. Nonetheless, the predicted stand alone ratings produced by the model make it clear that US states are, indeed, over-rated and, in all likelihood, receiving a credit subsidy, in the form of lower yields and coupons, from the federal government. We turn now to pricing that subsidy.

5. Models of Credit Subsidies

In the previous literature on the topic of valuing credit subsidies, there are four suggested methodologies for valuing a credit subsidy. The treasury-rate method, the market-rate method,

the options-pricing method, and the Ohlin formula have all been used in the past[19]. This section reviews the methodology of each.

The treasury-rate approach is the method recognized by the Federal Credit Reform Act (FCRA) of 1990. Prior to the FCRA, the federal government priced credit subsidies by the cash inflows and outflows experienced in any given fiscal year. The method adopted in 1990 and still used at the time of this writing transforms how the federal government accounts for the subsidies from a cash basis into an accrual basis. This method is primarily used to price the value of subsidies explicitly given by the US Federal Government into the fiscal year budget of the government. For example, this was the method used in valuing the credit subsidy given to airlines in the wake of September 11th as a result of the Air Transportation Safety and System Stabilization Act. The method calculates the value of the subsidy using the following formula:

$$S = LGD * PD * PV$$

Where:

S = the value of the subsidy
LGD = Loss given default
PD = Probability of default
PV = Present Value of the Loan

The FCRA method discounts future cash flows at treasury rates whereas risky cash flows should be discounted at a rate that reflects their riskiness (namely, the market rate.)[20] Despite the simplicity of this model, there are several major flaws that cause the federal government to underestimate the amount of credit risk it is taking on when guaranteeing debt. First, given that future cash flows are being discounted at the risk-free rate, the probability of default should

[19] With the exception of the Ohlin formula, the material in this section is heavily drawn from the CBO publication, "Estimating the Value of Subsidies for Federal Loans and Loan Guarantees"
[20] In this paper, the present value of the future cash flows of the State General Obligation Bonds is discounted at their yields at the time of issue as opposed to the treasury rates.

represent the risk-neutral probability of default, not the historical probability of default. However, because of available data, only the historical probability of default is available and, subsequently, used. Secondly, estimating the probability of default and the loss given default is not a trivial task. Determining both of those values does not arise easily and changes overtime. These inconsistencies aside, the federal government currently and in the foreseeable future will use this method to price the value of its explicit subsidies. As such, this method should be employed as a first order measure to price the value of the implied federal subsidy.

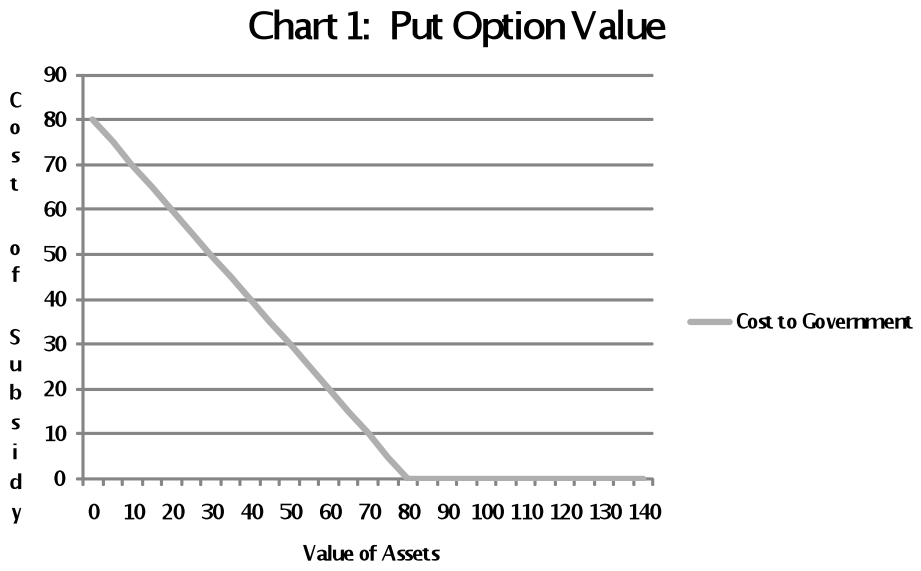
In order to account for the fact that the treasury-rate method does not take into account the inherent riskiness in the future cash flows, the market-rate method is also applied. The market-rate method looks at what the value of the bond would have been if the subsidy were not taken into account. This is done by using the stand alone credit ratings, as described above. In order to determine the price of the subsidy, the present value of the general obligation bond is found under the 'real' rates (that is, the present value under market conditions.) Then, a new yield is used, reflecting the predicted stand alone riskiness of the credit (as determined by the predicted credit rating) to discount the future expected cash flows to determine what the actual value of the bond should be. Because, in most cases, the predicted yield will be higher than the 'real' yield, the true bond price should be lower than the actual present value of the bond. As a result, the difference between what the predicted price and the 'true' price represents the subsidy given to the state. Simply put, if the state had issued the same bond but the market did not give it more favorable terms because of the implied federal guarantee, than the state would have collected (at $t = 0$) less cash from the issuance. The difference, in cash it did receive and cash it would have received without the implied guarantee, represents the value of the subsidy.

As an example, let's suppose that, with the implied federal guarantee, a state's spread over the treasury rate is 200bps whereas it would have been 500bps without the federal guarantee. Let's further suppose that the treasury rate is 100bps. If a state were to issue a 5 year bond with a 3% coupon and $100 principal, the present value of that bond, with the implied federal guarantee, would be $100. However, if the state issued a similar bond, but there existed no implied federal guarantee, than the bond would only have a present value of $91.48.[21] As such, the subsidy is worth $8.52.

The options pricing model differs from the market-rate model in that it views the loan guarantee as an option on the assets of the entity receiving the guarantee. Just as equity is a put option against the assets of a corporation, a credit guarantee can be viewed using the same principle (assuming the corporation has no equity.) Let's suppose that a company has $100 of assets and $80 of loans to be repaid in 1 year, which the government has guaranteed. Further assume that the value of the assets will fluctuate such that so long as the value of the assets is greater or equal to $80, the government does not incur any expense (that is, the guarantee is not exercised); however, should the value of the assets fall below $80, the federal government will owe the debt holder $80 minus the value of the assets.

In this example, the government, essentially, owns a put option against the value of the assets with a strike price at the value of the loans ($80.) The 'payoffs' of the put are represented by Chart 1.

[21] The present value of the bond payments is calculated by deriving the value of the annuity of semi-annual coupon payments and adding the present value of the principal paid at the time of maturity



Given the structure of the cash flows and the optionality inherent in them, the value of this structure can be priced using a variety of methods. The CBO uses a discrete binomial model while a continuous model of options pricing, either using Black-Scholes (1973) or Merton (1973), would also provide a value to the government subsidy. However, in either case, the value of the company's assets must be easy to ascertain. Should the company have equity, the market's value of the assets of the firm can be tracked on a daily basis. Even if the company does not have equity, the value of the assets (though not on nearly as dynamic a basis) can be valued as well. For states, however, the true value of their assets lies in their ability to tax now and in the future. Valuing this asset, the greatest asset any sovereign generally has, is a non-trivial task that is not the subject of this paper. Therefore, because of the limitations available in modern finance theory to accurately value the assets of a state or a sovereign, this method is not used to price the value of the subsidy given to US States.[22]

[22] We note Gapen, Michael et al. attempt to price sovereign assets in their working paper published through the IMF entitled, "Measuring and Analyzing Sovereign Risk with Contingent Claims"; however, this model is based off of the distinctions between foreign and local currency denominated debt. Such a feature does not exist in state debt and, as such, this model has little applicability to state finances (or finances of sovereigns without foreign currency denominated debt.)

Lastly, the OECD requires member states to use the Ohlin formula to price their agricultural subsidies. As a result, this method has been used to price subsidies in trade disputes heard by the World Trade Organization. Despite its heavy use in such cases, the original derivation of the formula is not cited by any papers the author found. However, despite the fact that the formula's original derivation seems lost, the principles of the formula are easy to come by and, once more, the formula is a popular method of arriving at subsidy values as used by the OECD. As such, it should provide yet another estimate on what the true value of the federal implied guarantee on US state debt is. The Ohlin formula derives the subsidy rate as follows[23]:

$$R = 100 * (1 - D) * \left(1 - \frac{g}{r}\right) * \left(1 - \frac{\frac{1}{\left(1+\frac{r}{a}\right)^{aG}} - \frac{1}{\left(1+\frac{r}{a}\right)^{aT}}}{r(T-G)}\right) - f$$

Where:

R = Subsidy Rate
T = Term of loan
G = Grace period = 0
D = Down payment = 0
g = annual subsidized interest rate
r = annual discount rate (rate without subsidy)
a = payments per year
f = fee rate = 0

The grace period (G), down payment (D), and fee rate (f) all take on the value of zero in this use of the model because the states still service their debt (that is, there is no grace period when they do not have to service their debt), they do not make any down payment on the debt prior to

[23] "An Analysis of Officially Supported Export Credits in Agriculture" as published by the OECD. < http://www.oecd.org/dataoecd/48/45/1911035.pdf>

servicing it, and there is no fee paid to the federal government for the implied guarantee. As such, the re-derived formula, with those values set equal to zero, is a follows:

$$R = 100 * (1 - \frac{g}{r}) * (1 - \frac{1 - \frac{1}{(1 + \frac{r}{a})^{aT}}}{rT})$$

6. Data – Value of Subsidy

In order to value the subsidy each state receives, a number of different data sets need to be collected. We report on each here.

The first set of data required for each method is the number of bonds issued by each state from 2007 to 2010, the date each was issued, the maturity date, the coupon value, and the yield at the time of issue. This data is obtained via Bloomberg. Using its municipal bond search function, we search for bonds by issuer (where each issuer specified is one of the fifty US states.) To further narrow our search, we search only for general obligation bonds (of any type) issued from January 1, 2010 to the present. This data results in over 9,200 bonds and CUSIP numbers produced by Bloomberg.

Next, for method one, an appropriate historical probability of default and loss given default needs to be estimated. For the loss given default, 25% is used as the standard. For the probability of default, however, the average of S&P's historical default by rating is used (see Table 6.) The predicted rating of each state is used to calculate its probability of default.

Table 6: 5 Year Probability of Default

Rating of Issuer	Sovereign	Private Sector	Average
AAA	0.0	0.3	0.2
AA	0.0	0.3	0.2
A	0.0	0.6	0.3
BBB	4.7	2.4	3.6
BB	7.8	9.3	8.6
B	14.3	21.1	17.7
CCC/CC	52.9	44.5	48.7

For the market-rate method and Ohlin formula, the predicted stand alone market rate (yield) for each state needs to be computed. Typically, for corporate bonds, the Capital Asset Pricing Model (CAPM) would be used to determine the appropriate rate by which the risky cash flows should be discounted by. However, given that states do not issue equity that can be correlated with the market (beta), the CAPM fails to derive the stand alone market rate in this case. However, in order to arrive at an approximation of the stand alone yield, the average yield among similarly rated companies is used as a proxy. These values are derived from Barclay's Capital (formerly Lehman Brothers) Aggregate Bond Index for intermediate and long term maturity AAA-, AA-, A-, and BBB-rated corporate debt. The index commutes the average yield on a daily basis and, as such, the market-rate model and the Ohlin formula can use the average corporate yield for the same rating class as the bond being issued on the very day it was issued.

The only remaining problem is the fact that the Barclay's index reports maturity in terms of intermediate and long-term. On average, the intermediate term index averages around 5 years. As such, bonds with a maturity of less than 10 years were priced using the intermediate term index while bonds with a maturity of 10 years or greater were priced using the long term index. Using this information, we move on to reporting the results of the subsidy analysis.

7. Results – Value of Subsidy

Results from the previously described analysis are listed in Table 7. Arizona, Colorado, Idaho, Indiana, Iowa, Kansas, Kentucky, Nebraska, North Dakota, South Dakota, and Wyoming do not issue General Obligation Debt; as such, no subsidy is reported for them. Additionally, given that California did not experience a downgrade based on the model discussed above, no subsidy is reported. The total subsidy is reported in Table 8. It ranges from $717 million under the FRCA method to $74 billion under the market-rate method.

In comparison to the over $14 trillion the United States currently has outstanding in debt, even the $74 billion value of the subsidy is a fractional value. Further, even when compared to recent federal deficits, the $74 billion subsidy value figure is still relatively small, given that deficits in the past two years were over $1.2 trillion and $400 billion three years ago.[24] Despite the subsidy's small value relative to the size of US Federal debt and deficits, it must be remembered that this value merely represents that value that the United States Federal Government should be accounting for on its balance sheet. Should states actually fail, this value will be much higher, but, at this time, given the relative credit risk of each state that the federal government is subsidizing, this value represents the expected loss to the government from their implied guarantee program.

[24] Meeker, Mary "USA Inc.: A Basic Summary of America's Financial Statements" February 2011, pg 27

Table 7: Estimated US State Subsidy Values (2007 - 2010)

State	Method 1	Method 2	Method 3		State	Method 1	Method 2	Method 3
Alabama	$769,675	$62,805,734	$37,928,650	2	Montana	$16,159,208	$1,087,533,096	$654,822,725
Alaska	$272,940	$39,491,216	$23,770,963	5	Nebraska*			
Arizona*				1	Nevada	$51,414,513	$7,936,772,714	$4,704,111,902
Arkansas	$26,197,150	$4,841,060,902	$2,897,828,150	2	New Hampshire	$579,848	$68,495,006	$41,537,079
California**				0	New Jersey	$1,031,635	$59,534,072	$35,349,603
Colorado*				4	New Mexico	$221,018	$22,563,524	$12,913,225
Connecticut	$108,980,449	$1,927,606,002	$1,157,121,053	5	New York	$1,130,119	$192,581,097	$118,590,438
Delaware	$78,520,913	$1,487,697,517	$891,404,365	7	North Carolina	$4,378,278	$423,272,624	$246,687,290
Florida	$7,850,872	$462,883,488	$287,215,790	5	North Dakota*			
Georgia	$11,095,954	$2,328,345,473	$1,394,909,122	5	Ohio	$11,023,812	$1,603,673,169	$941,661,974
Hawaii	$3,985,431	$715,825,396	$422,685,986	3	Oklahoma	$333,622	$11,190,751	$6,816,985
Idaho*				2	Oregon	$117,075,465	$17,820,523,128	$10,303,854,710
Illinois	$78,263,507	$297,389,443	$179,084,979	3	Pennsylvania	$7,956,810	$905,096,561	$533,841,420
Indiana*				4	Rhode Island	$4,310,720	$179,266,912	$106,260,517
Iowa*				5	South Carolina	$31,046,130	$7,938,374,541	$4,780,905,738
Kansas*				4	South Dakota*			
Kentucky*				1	Tennessee	$8,881,685	$1,241,679,791	$747,068,569
Louisiana	$2,490,786	$14,672,779	$10,594,804	2	Texas	$50,332,814	$7,353,402,985	$4,383,017,992
Maine	$8,629,698	$514,625,155	$302,201,089	2	Utah	$2,049,804	$188,546,819	$113,346,887
Maryland	$3,274,435	$434,829,864	$255,670,131	5	Vermont	$13,899,381	$1,419,861,346	$824,374,419
Massachusetts	$7,303,056	$1,260,457,807	$770,758,648	4	Virginia	$2,113,685	$207,902,030	$125,370,071
Michigan	$6,444,401	$3,103,507,021	$1,886,165,274	1	Washington	$12,334,381	$2,714,829,530	$1,612,982,751
Minnesota	$8,793,379	$775,871,221	$458,263,455	5	West Virginia	$17,852	$2,834,003	$1,643,745
Mississippi	$15,261,335	$3,214,154,776	$1,909,878,374	1	Wisconsin	$6,649,680	$951,025,485	$558,513,222
Missouri	$6,423,133	$524,828,704	$293,032,419	5	Wyoming*			

*State does not issue General Obligation Debt

**California did not get a downgrade in our model. As such, we did not test for subsidies

Table 8: Total Value of Subsidy (2007 - 2010)

	Method 1	Method 2	Method 3
United States of A	$717,497,575	$74,335,011,681	$44,032,184,512

8. Conclusion

This paper sought to determine which states were receiving a subsidy from the federal government and value that subsidy. To determine which states were receiving a subsidy, we developed a model for sovereign credit ratings and applied said model to all fifty states. The results indicate that every state, with the notable exception of California, is receiving a subsidy. Further, it appears that smaller states, or states that get less press attention regarding the size of their debt, are usually the most overrated. We posit, but do not attempt to prove, that this may be a result of S&P being more scrupulous with larger states rather than with smaller states.

The fact that almost every state is overrated based on our model leads us to believe that S&P is pricing in the value of an implied federal guarantee of state debt when approximating the credit risk of each state. This fact allowed us to use three methods (FCRA, market-rate, and the Ohlin formula) to price the value of the subsidy each state is receiving based on this implied federal guarantee of their debt. The three methods produce a range of total subsidy values across the United States ranging from $700 million to $74 billion. In the context of US Federal debt and deficits, this value is relatively small; however, it currently represents the expected loss to the federal government as a result of its implied guarantee of state debt. If the states' fiscal situation continues to deteriorate and their riskiness increases, this value will only increase and, if it ever were to be realized in the event of a US state default event the value would be much larger.

Our findings can be seen as a relief to the US federal government – the expected loss due to the federal government's implicit guarantee is small relative to its debt burden and, at this time, the US federal government would, in all likelihood, have little problem raising such money in the capital markets. However, these findings also serve to alert the federal government and

investors of the value of the guarantee that is currently not being accounted for, in any way, on the US federal government's balance sheet.

Additionally, these findings, as they stand now, are partially incomplete. US state pension plans are at historically underfunded levels. Depending on how these liabilities are valued, the liability ranges anywhere from $1 to $2 trillion. Given that for all states, these pension liabilities are at least as senior, if not more senior, to the general obligation debt of the state, the US federal government is also implicitly guaranteeing them.[25]

Given the size of US state debt and the potential for possible 'bailouts' of US states, further research on this topic is warranted. Future research may explore improving the sovereign model, developing a model based solely on subsovereigns and applying it to states, determining if US states are implicitly guaranteeing municipal debt and adding that implied guarantee to the federal guarantee as it would flow through the state to the federal government, obtaining a better proxy for the predicted stand alone yield than the Barclay's index, or valuing the implicit guarantee as it relates to state pension plans.

[25] Novy-Marx, Robert and Joshua Rauh "Public Pension Promises: How Big Are They and What Are They Worth?" Forthcoming in Journal of Finance <http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1352608>

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Appendix

Credit Rating Numerical Transformation Table

Rating	Numeric Value
AAA	1
AA+	2
AA	3
AA-	4
A+	5
A	6
A-	7
BBB+	8
BBB	9
BBB-	10
BB+	11
BB	12
BB-	13
B+	14
B	15
B-	16
CCC+	17
CCC	18
CCC-	19
CC+	20
CC	21
CC-	22
C+	23

Summary Statistics: Sovereign Ratings Model

Variable	Mean	Std. Dev.	Min	Max
Ratings	3.212	2.902542854	1	13
GNI Per Capita	28337.64	16211.99696	2840	84840
Long-term Unemployment	33.8612	16.42357176	1.2	73.1
GDP Per Capita	30249.35883	18380.5964	3049.591829	117954.6797
Consumer Price Inflation	3.022002824	2.22521146	-1.129479413	16.58560509
Projected GDP Growth	3.114172	1.248607272	0.096	7.5
Population Growth	0.61241645	0.627846563	-0.833338156	2.530085489
Budget Deficit to Government Revenues	-0.038428101	0.186739161	-0.5386956	0.70842688
Central Government Debt to GDP	52.77027401	29.01676425	3.608722546	127.3808444
Central Government Debt Per Capita	1483581.096	952797.2544	17827.89217	4396516.151
Central Government Debt Per Capita to Income Per Capita	55.43920569	29.83324838	4.216483747	146.3736146
Debt Service Payments To Tax Revenues	7.154623299	4.377092093	0.125440883	25.41145083
Compensation of Employees to Government Expenses	15.60854862	7.44014925	5.019315776	34.39844187
Debt Service to GDP	150.6996894	99.39038281	1.942446514	500.5325158
Debt Service Per Capita	3960.824343	2625.711082	8.885746074	11121.69992
Debt Service per capita to Income Per Capita	4559.747481	8110.457229	2.649686443	45237.00867
Debt Service to Tax Revenue	7.154623299	4.377092093	0.125440883	25.41145083
Government Spending to GDP	34.72170718	7.132052045	14.92200471	46.4357331