Forecasting State and Local Government Spending:

Model Re-estimation

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Equation

The REMI government spending estimation assumes that the state and local government demand are driven by the regional economic condition and changes in population. When the population of a given region increases, the government spending of the region is expected to increase as well in order to maintain the same level of services. Meanwhile, the state and local government spending is restricted by the budget, which is affected by changes in economic condition. It is assumed that the state and local government spending depends on the changes in per capita GDP, population, and unobserved fixed regional effects to different extents; the state and local government spending are estimated by two separate equations.

The state government demand equation has the following form

$$SG_t^k = R_{SG}^k * \left(\frac{GDP_t^k / N_t^k}{GDP_t^u / N_t^u} \right)^{\beta} * \frac{SG_t^u}{N_t^u} * N_t^k \qquad (1)$$

The local government demand equation has the following form

$$LG_t^k = R_{LG}^k * \left(\frac{GDP_t^k / N_t^k}{GDP_t^u / N_t^u} \right)^{\gamma} * \frac{LG_t^u}{N_t^u} * N_t^k \qquad (2)$$

Where,

SG = state government expenditures in chained 2012$;

R_{SG}^k = regional calibration factor for state government expenditures;

LG = local government expenditures in chained 2012$;

R_{LG}^k = regional calibration factor for local government expenditures;

GDP = gross domestic product in chained 2012$;

N = population;

β = GDP elasticity of state government expenditures;

Υ = GDP elasticity of local government expenditures;

k = state;

t = time;

u = U.S.

A problem with the model equations is the simultaneity between the current GDP and the government expenditures. The endogeneity will cause some of the model statistics to be biased. On the other hand, it is believed that there is a time lag for the impact of economic condition changes to fully take place and for the policy makers to respond accordingly. Thus, we modified the model equations by substituting the current relative per capital GDP with the moving average of relative per capital GDP, which is a weighted average of the current and past relative per capita GDP. After comparing different values, 0.5 is chosen as the speed of adjustment of the moving average (λ), which is the same value in the old estimation. The new state and local government spending equations are:

$$SG_t^k = R_{SG}^k * \left(GDP\_pc\_A_t^k\right)^{\beta} * \frac{SG_t^u}{N_t^u} * N_t^k \quad (3)$$

$$LG_t^k = R_{LG}^k * \left(GDP\_pc\_A_t^k\right)^{\Upsilon} * \frac{LG_t^u}{N_t^u} * N_t^k \quad (4)$$

Where,

$$GDP\_pc\_A_t^k = \begin{cases} GDP\_pc_t^k, & if\ t = 0; \\ (1-\lambda) \cdot GDP\_pc_t^k + \lambda \cdot GDP\_pc\_A_{t-1}^k, & otherwise. \end{cases}$$

$$GDP\_pc_t^k = \frac{GDP_t^k / N_t^k}{GDP_t^u / N_t^u};$$

λ = the speed of adjustment of the moving average.

Equation (3) and (4) are transformed into linear equation (5) and (6) by taking natural logarithms of both sides of the equations. Equation (5) and (6) are estimated using a fixed effects model. By using a fixed effects model, it is assumed that states share the same slope but have different intercepts, which are the unobserved state-specific factors that affects the state and local government spending.

$$\ln\left(\frac{SG_t^k/N_t^k}{SG_t^u/N_t^u}\right) = \ln\left(R_{SG}^k\right) + \beta * \ln\left(GDP\_pc\_A_t^k\right) + \varepsilon_t^k \quad (5)$$

$$\ln\left(\frac{LG_t^k/N_t^k}{LG_t^u/N_t^u}\right) = \ln\left(R_{LG}^k\right) + \Upsilon * \ln\left(GDP\_pc\_A_t^k\right) + \varepsilon_t^k \quad (6)$$

Data

State-level GDP in chained 2012 dollars is from BEA. This data source also decides our choice for the time period is from 1997-2019, because GDP data has been compiled since 1997 under NAICS system. Population numbers also came from the BEA website[1].

There are no direct source for government spending. But Government Finances Datasets from Census Bureau provide data for government expenditure for both state and local government for all 50 states and DC.[2] This program is the only known comprehensive source of state and local government finance data collected on a nationwide scale using uniform definitions, concepts, and procedures.[3] The change of government expenditure is used as the proxy for change of government spending in our model. Government expenditure is available in fiscal year instead of calendar year. For example, the first available fiscal year in our data set is 1996-1997. When building the model, the same time period GDP corresponding to 1996-1997 government expenditure will be the GDP in 1997. The half year time lag can, to some extent, reduce simultaneity between GDP and government expenditure, thus can minimize endogeneity problem of the model.

Table 1 compares the changes in state and local government expenditures (combined and individually, in real terms) with the total change in private GDP and population, by state, for the years 1997-2019. For the US as a whole, while population increased by 20.42% over the twenty-three year period, combined state and local government expenditures increased by 74.92%, state expenditures alone increased by 85.90%, and local expenditures by increased 63.18%. The variation among the states is relatively dramatic. Only one state, West Virginia, increased state

[1] https://apps.bea.gov/iTable/iTable.cfm?reqid=70&step=1&acrdn=2
[2] Government Finances Datasets (census.gov)
[3] 2019_methodology.pdf (census.gov)

and local government spending while their population decreased. All other states had government spending increase, private GDP and population growth.

Seven states (Illinois, Michigan, New York, Ohio, Pennsylvania, Rhode Island, and Vermont) increased either their state or local government spending by more than ten times the rate of their growth in population. Nevada experienced the fastest population growth, at 75.2%, and increased its growth of combined state and local government expenditures by 83.03%, which is above the state average increase of 67.77%. North Dakota had the fastest local government spending and private GDP growth at 123.92% and 163.76%, while Oregon had the fastest combined government spending and state government spending growth at 118.7% and 153.76% respectively. Most states grew state and/or local government expenditures faster than the growth of GDP and population.

Table 1: Change in State and Local Government Expenditures, Private GDP and Population (1997-2019)

Nation	Combined State and Local Government Expenditures	State Government Expenditures	Local Government Expenditures	Private GDP	Population
United States	74.92%	85.90%	63.18%	70.00%	20.42%
State	**Combined State and Local Government Expenditures**	**State Government Expenditures**	**Local Government Expenditures**	**Private GDP**	**Population**
Alabama	57.95%	70.20%	42.90%	44.64%	12.36%
Alaska	18.88%	20.32%	15.84%	27.48%	19.68%
Arizona	98.61%	134.94%	65.34%	103.84%	53.93%
Arkansas	78.72%	97.18%	48.96%	46.33%	16.14%
California	113.06%	134.66%	93.20%	115.88%	21.40%
Colorado	111.64%	134.89%	91.93%	105.05%	43.31%
Connecticut	37.14%	32.25%	44.72%	34.80%	6.47%
Delaware	79.17%	89.08%	57.47%	41.56%	29.96%
District of Columbia	91.39%		91.39%	77.15%	24.75%

State	Combined State and Local Government Expenditures	State Government Expenditures	Local Government Expenditures	Private GDP	Population
Florida	63.38%	71.62%	56.65%	81.29%	41.52%
Georgia	56.63%	56.93%	56.31%	73.77%	38.29%
Hawaii	42.18%	36.37%	63.06%	53.31%	16.83%
Idaho	97.45%	117.02%	71.96%	119.32%	45.63%
Illinois	56.40%	61.80%	51.05%	37.73%	3.95%
Indiana	57.64%	72.63%	41.13%	50.02%	13.03%
Iowa	63.28%	70.41%	54.61%	57.79%	9.29%
Kansas	62.70%	79.67%	45.35%	60.21%	10.52%
Kentucky	57.23%	71.83%	32.86%	34.62%	13.15%
Louisiana	26.99%	37.11%	12.69%	21.21%	5.37%
Maine	32.36%	35.60%	26.97%	42.03%	7.25%
Maryland	82.03%	89.70%	72.69%	77.71%	17.40%
Massachusetts	70.22%	83.85%	50.65%	81.36%	10.74%
Michigan	32.55%	47.91%	14.08%	23.65%	1.79%
Minnesota	61.96%	80.90%	41.16%	68.27%	18.40%
Mississippi	45.50%	54.84%	32.11%	25.74%	7.25%
Missouri	52.14%	56.98%	46.72%	28.89%	12.03%
Montana	46.31%	50.79%	38.64%	74.49%	20.26%
Nebraska	56.66%	49.63%	62.32%	75.05%	14.60%
Nevada	83.03%	100.63%	67.67%	74.24%	75.20%
New Hampshire	76.98%	89.88%	60.62%	68.07%	14.41%
New Jersey	49.60%	74.09%	20.88%	34.73%	8.18%
New Mexico	101.89%	130.59%	55.37%	61.51%	18.30%
New York	54.57%	60.88%	49.07%	58.41%	4.32%
North Carolina	71.93%	80.77%	62.31%	66.05%	37.15%
North Dakota	115.91%	111.22%	123.92%	163.76%	17.55%
Ohio	47.95%	55.03%	39.13%	35.29%	3.72%

Oklahoma	63.71%	77.60%	45.09%	80.75%	17.43%
Oregon	118.70%	153.76%	78.23%	104.31%	27.59%
Pennsylvania	63.65%	78.39%	45.90%	52.44%	4.67%
Rhode Island	52.54%	53.77%	50.28%	40.43%	3.20%
South Carolina	73.45%	69.74%	78.84%	65.01%	33.63%
South Dakota	67.52%	70.60%	63.40%	105.40%	19.20%
Tennessee	52.38%	57.60%	47.89%	62.77%	24.21%
Texas	115.05%	124.76%	106.00%	111.46%	46.84%
Utah	95.35%	106.52%	81.90%	126.25%	51.12%
Vermont	110.55%	121.31%	92.26%	53.10%	4.49%
Virginia	77.41%	94.91%	58.27%	72.75%	25.30%
Washington	80.20%	75.84%	85.14%	115.24%	34.17%
West Virginia	20.56%	27.95%	5.26%	25.35%	-1.31%
Wisconsin	39.80%	55.15%	23.51%	52.64%	10.60%
Wyoming	65.95%	64.57%	67.65%	58.37%	18.52%

Figure 1 and 2 show the percentage change in state and local government spending per capita over the available data time period. The 50 states and DC reveal diversified changes over the period 1997-2019. Vermont and North Dakota have experienced the highest increase in state and local government spending respectively among the 51 regions. Alaska had the lowest increase in state government spending, while Nevada had the highest percentage of drop in local government spending.

Figure 1: Percentage Change in State Government Spending per Capita 1997-2019

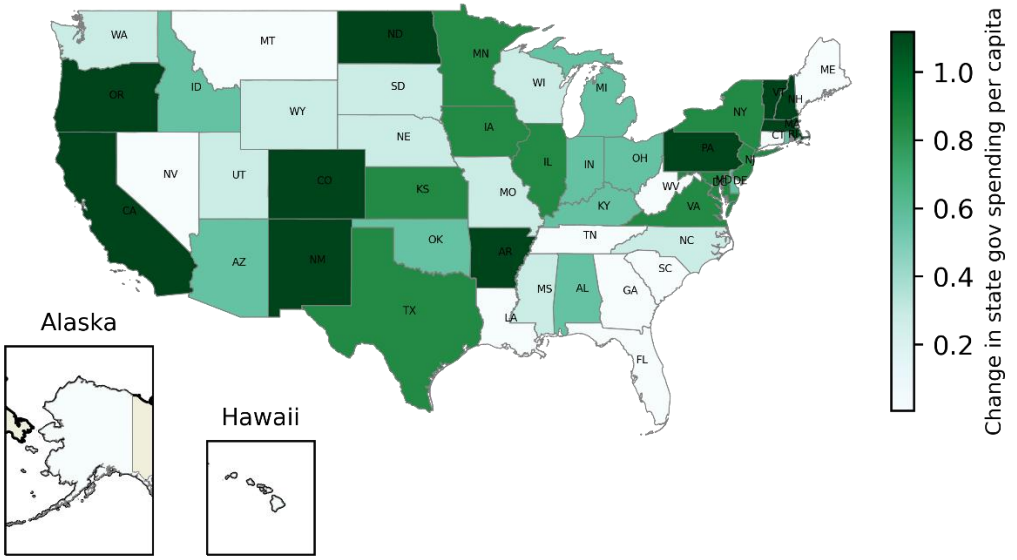


Figure 2: Percentage Change in Local Government Spending per Capita 1997-2019

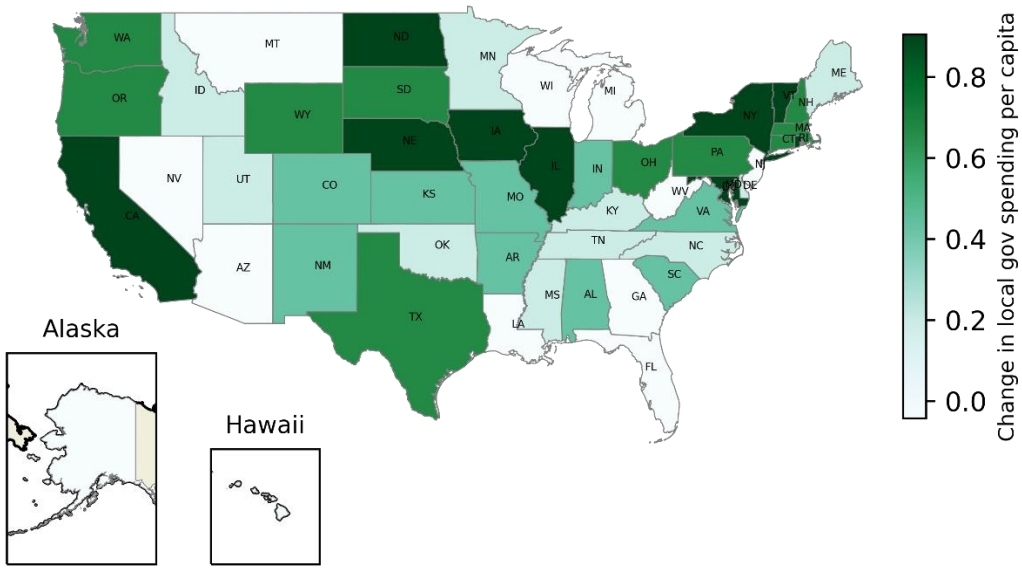


Figure 3 and Figure 4 show positive correlations between government spending per capita and private GDP per capita in year 2019, which adds credibility to model equations. Note that Alaska and District of Columbia are removed from scatter plots below because of the plot range.

Figure 3: State Government Spending per Capita and Private GDP per Capita (2019)

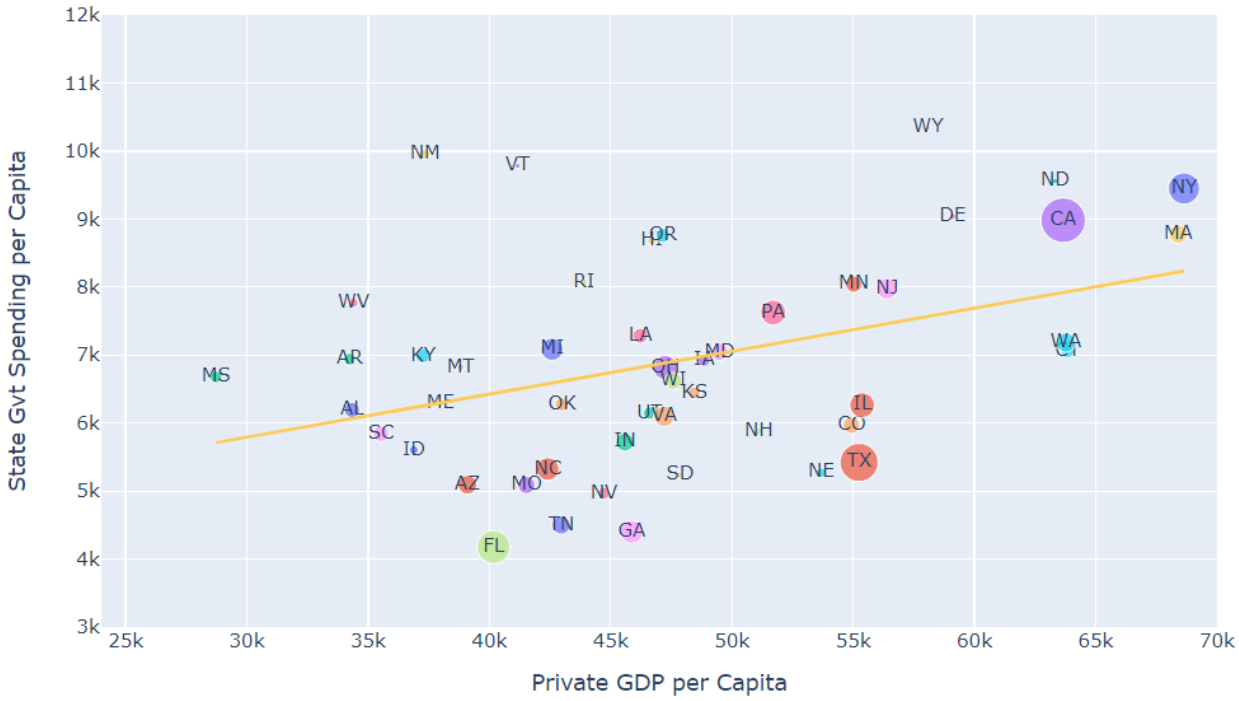
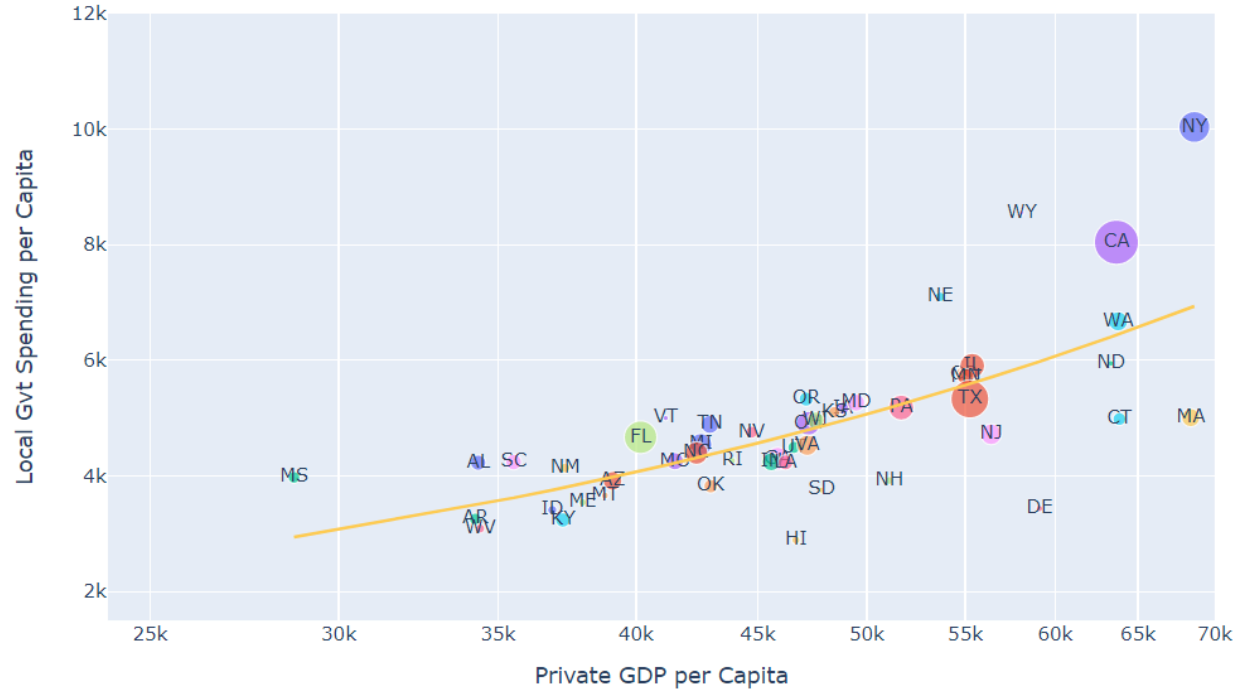


Figure 4: Local Government Spending per Capita and Private GDP per Capita (2019)



The data set we used is panel data set. For state government spending model, the data set consists of 1,050 observations, with 50 regions and 21 time periods.[4] For the local government spending model, the data set consists of 969 observations, with 51 regions and 19 time periods. [5] And the moving average starts in year 1999, which means older years (year 1997 and 1998) are removed.

Results

A fixed effects model is used to estimate state and local government spending respectively. The estimation results are shown in Table 1. The coefficients are estimated to be 0.43935 and 0.61573 respectively for state and local government spending, which are higher than year 2015 old estimates (0.3769 and 0.4979). The explanatory variable is significant at 0.01 level in both models. The coefficients show that the per capita GDP moving average variable has a stronger effect on local government spending compared to state government spending.

Table 2: Fixed Effects Estimation of New Equations

Model	Independent Var.	Est. Coeff.	Robust Std. Err.	t-value	N
state government spending	Beta	0.43935	0.0795	5.53***	1,050
	Constant	0.06214	0.0049	12.62***	
local government spending	Gamma	0.61573	0.0804	7.66***	969
	Constant	-0.09597	0.0034	-28.1***	

Note: *** denotes 0.01 significance level

The higher coefficients suggest a stronger effect of GDP per capita on government spending. The state and local government spending animations below both show clear upward trends between government spending per capita and private GDP per capita from year 1997 to year 2019, which visually explain the higher coefficients.

[4] Observations for DC is dropped since there is no state government spending for DC.
[5] Local government expenditure for the fiscal year of 2000-2001, 2002-2003 are not available.

Table 3 presents the state-specific calibration factors. For the state government spending model, Alaska has the highest calibration factor at 2.349, while Texas has the lowest at 0.739. For the local government spending, District of Columbia has the highest calibration factor at 2.273, and Hawaii has the lowest at 0.473.

Table 3: State Calibration Factors

Region	State government spending	Local government spending
Alabama	1.080	1.005
Alaska	2.349	1.100
Arizona	0.854	0.941
Arkansas	1.156	0.747
California	1.124	1.243
Colorado	0.823	0.982
Connecticut	1.071	0.727
Delaware	1.181	0.541
District of Columbia	1.000	2.273
Florida	0.742	1.049
Georgia	0.754	0.886
Hawaii	1.385	0.473
Idaho	0.983	0.776
Illinois	0.876	0.987
Indiana	0.878	0.830
Iowa	1.027	0.941
Kansas	0.952	0.959
Kentucky	1.187	0.725
Louisiana	1.116	0.875
Maine	1.186	0.769
Maryland	1.021	0.908
Massachusetts	1.143	0.804
Michigan	1.093	0.982
Minnesota	1.128	0.989
Mississippi	1.307	1.039
Missouri	0.845	0.840
Montana	1.226	0.808
Nebraska	0.835	1.230
Nevada	0.756	0.954
New Hampshire	0.881	0.717
New Jersey	1.107	0.877

New Mexico	1.547	0.929
New York	1.274	1.508
North Carolina	0.904	0.893
North Dakota	1.247	0.835
Ohio	1.084	0.947
Oklahoma	1.036	0.759
Oregon	1.197	0.991
Pennsylvania	1.066	0.925
Rhode Island	1.265	0.789
South Carolina	1.142	0.937
South Dakota	0.864	0.736
Tennessee	0.784	1.005
Texas	0.739	0.889
Utah	0.994	0.833
Vermont	1.550	0.843
Virginia	0.888	0.845
Washington	1.031	1.020
West Virginia	1.365	0.743
Wisconsin	1.093	0.980
Wyoming	1.462	1.323