Perspectives on the Geographic Variation in Health Care Spending

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Introduction

Health care reform is definitely at the top of the domestic policy agenda. But before we move ahead on significant changes in the health care markets in the United States, it is critical that we flesh out our understanding of one of the leading rationales for reform. The argument goes something like this. Health care spending varies dramatically from region to region without producing commensurate variation in health outcomes. Indeed, higher health care spending per capita is not consistently associated with better health outcomes. The observed disconnect between health care spending and outcomes suggests that through a more efficient use of health resources, spending could be cut substantially.

Most of the evidence cited in support of this line of reasoning comes from the regional variation in Medicare spending. Medicare spending does indeed vary significantly from region to region, however the regions are defined – state, county or hospital referral regions. Because our focus in this paper will be state-to-state variation, let's consider average Medicare payments per beneficiary in the states with the highest and lowest spending: Louisiana and South Dakota. In 2004, the last year in the data we use, average Medicare spending in Louisiana was $8,659 while spending in South Dakota was $5,640, almost 35 percent less. While some of the variation in Medicare spending can be linked to a state's income, demographics, health market conditions and the population's underlying health risks, there remains some persistent variation that has often been attributed to differences in the way health care is practiced. A reform encouraging high spending area providers to take up the style of practice in the low spending areas of the country is seen as one important way of reducing Medicare spending specifically, and health care spending in general.

Even if it were possible to transform the style of practice for the Medicare population in a way that was costless and achieved the suggested reduction in Medicare expenditures, would such a change equalize general health care expenditures across states? Such a result depends on the assumption that Medicare expenditures and general health care expenditures are closely related. However, the same pattern of regional variation observed for Medicare spending does not necessary hold when other measures are used. For example, suppose we use a state's per capita health care spending to identify variation. This measure includes spending by all residents in a state, young and old, Medicare and Medicaid beneficiaries, those covered by private health insurance and those who do not have health insurance. Based on this measure, the average in Louisiana is $5,040 but the average spending in South Dakota is now higher at $5,327. Rather than having the highest spending, as it did in the Medicare rankings, Louisiana now ranks 36th among the 50 states while South Dakota moves from lowest to the 25th position. This is just one illustration that the lessons to be learned from geographic variation must take into consideration spending measures other than Medicare.

This paper begins by placing it in the context of other studies on geographic variation. Next, we identify the raw geographic variation in health care spending from several different vantage points. We will see that labeling states as high or low spending depends on the basis for the label used. We then identify the persistence in each spending measure over time. Given that persistence in spending is most prevalent for Medicare indicates that as a national program, it may be the least dynamic. The paper then considers the degree to which demographics, income, health conditions and health market controls help explain the regional variation in spending as well as its persistence. The next section identifies by how much health care spending could be reduced in a hypothetical calculation that assumes that spending could, without cost, become the

spending level at the 10th percentile in raw distribution and in the distribution that controls for observable state differences. The final section concludes.

Related Literature

Academic Literature - Geographic variation in health care spending can be identified at the county level, the hospital referral region level or at the state level. Previous studies have focused on Hospital Referral Regions (HRR) as defined in the *Dartmouth Atlas of Health Care.* The oft cited study by Skinner and Fisher (1997) examines variation in Medicare spending at the HRR level.[1] After adjusting for the effects of age, sex, race, illness and price levels on regional expenditures, they find considerable variation in spending from one area to another that is similar to the raw regional variation in spending. They estimate that if all regions of the country cut spending to the level in Richmond, Virginia, Medicare spending could be reduced 20 percent.

Cutler and Sheiner (1999) follow a similar methodology and again use the Dartmouth Medicare spending data at the HRR level combined with data at the MSA or state level. Before controlling for observable differences between the regions other than the *Dartmouth Atlas's* standardization by age, sex, race and price, they note that Medicare spending could be reduced 30 percent if spending is constrained to the spending at the 10th percentile in the distribution of spending. After adjusting for other observable differences between the regions such as illnesses, income, education and health market conditions, they conclude that Medicare spending could still be reduced by 15 percent if spending were constrained to the 10th percentile in the adjusted distribution. We will conduct a similar exercise in a later section.

[1] Jonathan Skinner and Elliott Fisher, "Regional Disparities in Medicare Expenditures: and Opportunity for Reform," *National Tax Journal*, Vol. 50, No. 3, September 1997. The *Dartmouth Atlas of Health Care* is available at: http://www.dartmouthatlas.org/

Other Articles - In a 2008 study, Hopson and Rettenmaier examine the variation in Medicare fee for service spending at the county level.[2] They identified the geographic distribution in fee-for-service average Medicare spending for the 65 and above population at the county level across the continental United States from 2001 to 2005. Similar to the earlier work on geographic variation, they find that after controlling for demographic, income, heath care risk profiles and several characteristics of the health care markets a consistent geographic pattern of high- and low-spending counties emerges.

The current interest in regional variation is evidenced by a 2008 Congressional Budget Office paper on the topic.[3] A recent *Wall Street Journal* op-ed by the current director of the Office of Management and Budget identified regional variation as evidence of inefficiency in Medicare spending.[4] Lastly, regional Medicare spending variation is also used to motivate a new essay on health care delivery in *The New Yorker*.[5] What these and the academic articles have in common is the use of Medicare spending as the gauge of health care spending. As we shall show, other gauges will give us different readings of the regional variation in health care spending.

State of Residence Health Care Spending Data

Geographic variation in health care spending can be identified at the county level, the hospital referral region level, or at the state level. In this paper we use state level data defined by state of residence that is available from the Centers for Medicare and Medicaid Services (CMS).[6]

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[2] Hopson and Rettenmaier, "Medicare Spending Across the Map," NCPA Policy Report No. 313, July 2008.
[3] Geographic Variation in Health Care Spending, Congressional Budget Office, February 2008.
[4]See Peter Orszag, "Health Costs Are the Real Deficit Threat," *Wall Street Journal,* May15, 2009.
[5] Atul Gawande, "The Cost Conundrum: What a Texas town can teach us about health care," *The New Yorker*, June 1, 2009.
[6] The data is available at the CMS website: http://www.cms.hhs.gov/NationalHealthExpendData/05_NationalHealthAccountsStateHealthAccountsResidence.asp#TopOfPage. See Anne B. Martin, Lekha Whittle, Stephen Heffler, Mary Carol Barron, Andrea Sisko and

This data spans the fourteen years from 1991 to 2004 and has several advantages for the current study. Importantly, it allows us to investigate variation in health spending measures other than Medicare over time. These other measures provide a more complete picture of geographic variation and will inform any proposed policy prescriptions. The data also allow us to consider how state level demographics, income and health market conditions, including the uninsured rate, help explain the distribution of spending.[7]

The reliability of this particular data set vis-a-vis the *Dartmouth Atlas* Medicare-based data has been called into question by Skinner, Chandra, Goodman and Fisher in a 2009 *Health Affairs* article.[8] Though they raise some serious issues about the state of residence data, particularly the per capita health spending metric, these concerns do not negate the value of considering alternative measures of geographic variation in health care spending. The particular data used here are developed by CMS and are fully compatible with the National Health Expenditure Accounts (NHEA). The concerns raised by Skinner, et al. are addressed in the data appendix.

Alternative Rankings of State Health Care Spending

Given that Medicare spending is often the metric by which geographic variation is defined, we begin with average Medicare spending by state as depicted in the first panel of

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Benjamin Washington, "Health Spending by State of Residence, 1991-2004," *Health Affairs,* September 18, 2007, for survey of the data and for a detailed description.

[7] The CMS also provides state level data based on the state of the provider of the health care that spans more years, 1980-2004, but for the research questions addressed here, the state of residence file is preferred. The state of provider data is available at: http://www.cms.hhs.gov/NationalHealthExpendData/05a_NationalHealthAccountsStateHealthAccountsProvider.asp#TopOfPage. Wang and Rettenmaier, in "A Note on Cointegration of Health Expenditures and Income," *Health Economics*, 16: 550-578 (2007), use these data to estimate state income elasticities over time. Wang in "The convergence of Health Care Expenditure in the U.S. States," *Health Economics*, 18: 55-70 (2009) also uses these data to establish the degree to which health care spending across the states has converged over time.

[8] See Jonathan Skinner, Amitabh Chandra, David Goodman and Elliot S. Fisher, "The Elusive Connection Between Health Care Spending and Quality," *Health Affairs,* Vol. 28, No.1 (2009) w119-w123.

Figure 1. Consistent with other studies, Louisiana, Maryland, New Jersey, Florida and Texas often top the rankings of per enrollee Medicare spending. All five states exhibit average Medicare spending in excess of $8,200 in 2004, or about $800 above the national average Medicare spending. The five states with the lowest per enrollee Medicare spending are South Dakota, Montana, New Mexico, Hawaii and Idaho, all with spending below $5,800. Thus, Medicare spending per enrollee for residents in states at the top of the distribution is about 40 percent higher than enrollee spending at the bottom of the distribution.

It is this variation that has been perceived as evidence of inefficiency in the delivery of health care in those states with the greatest Medicare expenditures that may be eliminated if practice patterns in low spending areas are adopted. However, as the right panel of Figure 1 illustrates, identifying high- and low-spending states using Medicare spending alone may mislabel many states. The right-hand panel of Figure 1 presents an alternative ranking based on per capita total health care spending. This ranking includes all residents in the state and spans all payers, public and private. While the correlation coefficient between the two rankings of 0.21 indicates that the two rankings are definitely correlated (as they should be given that Medicare spending and enrollees are included the state average), there is notable resorting. Consider the highest two and lowest two spending states in terms of Medicare spending and note their rankings in the per capita total spending distribution. Louisiana and Maryland move down from the top two positions in the Medicare rankings to the 36th and the 17th positions in the per capita total spending rankings, respectively. At the other end of the distribution, South Dakota and Montana move up from the lowest positions to 25th and 33rd, respectively.[9]

[9] Martin, et al. in "Health Spending by State of Residence, 1991-2004," *Health Affairs,* September 18, 2007 note the resorting that occurs when these two alternative rankings are used.

Another component of total health care spending is Medicaid spending. In contrast to Medicare, a federal program that essentially provides uniform health care insurance coverage for all retirees regardless of their current or lifetime earnings, Medicaid is a joint state and federal program that provides health insurance coverage for low income families. States determine eligibility and insurance coverage. Figure 2 depicts both of these dimensions. The left-hand panel presents average spending per Medicaid enrollee in 2004 and the right-hand panel presents the 2004 percentage of each state's population covered by this program. Spending per enrollee is highest in Alaska, New Jersey, New York, New Hampshire and Rhode Island. Alaska spent $10,400 per enrollee in 2004 and Rhode Island spent about $9,500. Spending per enrollee is lowest in California, Alabama, Arizona, Arkansas and South Carolina. South Carolina spends about $4,700 per enrollee and California spends only $3,600. Medicaid spending per beneficiary in Alaska is thus 2.8 times the per capita spending in California.

The right-hand panel shows the significant resorting that occurs when Medicaid is ranked in terms of the population covered by the program. In fact, the two ranking are negatively correlated with a correlation coefficient of -0.495. Alaska and New Jersey drop from the top of per enrollee spending rankings to the 30^{th} and 48^{th} position in the percent of the population rankings, respectively. California rises from the lowest Medicaid spending per enrollee to the state with the third highest percent of its population covered. This comparison indicates the interplay and tradeoffs states make in determining eligibility criteria and Medicaid benefit generosity.

Figure 3 provides two final ways of depicting geographic spending variation. The first panel shows per capita health care spending by the non-Medicare or Medicaid population.[10] This is the segment of the population that does not receive health care benefits through the two primary public programs. Alaska, Delaware, Maine, Vermont and Massachusetts top this ranking. At the other end of the distribution, Arizona, Utah, Louisiana, Georgia and Mississippi have the lowest health care spending by the non-Medicare or Medicaid population. Again, state level differences in demographics, income, etc. will help explain this variation, but it is clear that this ranking differs from the one based solely on Medicare spending. The right-hand panel in Figure 3 denominates personal health care spending by personal income in each state, producing a final way of thinking about geographic spending variation. Here the top ranking state is West Virginia, where health care spending is equal to almost 24 percent of state total personal income. At the other end of this ranking, health care spending in California is equal to only 13 percent of personal income. Medicare's and Medicaid's percentages are also depicted. Only in New York does their combined percentage approach 50 percent of the total spending. In Mississippi, Arkansas, Louisiana and New Mexico, the programs' combined percentage is in excess of 40 percent of total spending.

As Figures 1, 2 and 3 show, geographic variation is multi-dimensional and defining this variation by any one of these measures alone would lead to quite different policy suggestions. To further characterize the relationships, in Table 1 we present the correlation coefficients among the six rankings depicted in the previous figures. Of the 15 combinations, 10 have

[10] This series is derived from the CMS data set and other data sets. The denominator identifies the non-Medicare or Medicaid population by accounting for dual eligibles in the respective programs' enrollee populations. The dual eligible counts are from the Medicaid Statistical Information System and are available beginning in 1999. Earlier years are imputed using the national trend applied to the state data. The numerator is calculated by subtracting Medicare and Medicaid spending from total state spending as well as adjustments for spending by Medicare beneficiaries in addition to Medicare spending.

positive correlations while 5 have negative correlations. Personal health care spending per capita is positively correlated with all of its components – Medicare per enrollee, Medicaid per enrollee and non-Medicare/Medicaid per person with the correlation with the national program, Medicare, exhibiting the lowest. The negative correlations between the two public programs and between the public programs and the non-Medicare/Medicaid population's spending are also of interest and will be explored further in a later section.

Persistence in Spending over Time

Another way to distinguish inter-state spending patterns is a comparison of states' rankings in the various categories at different points in time. This intertemporal comparison will establish in which category of spending persistence is highest – at least before controlling for state characteristics. Figure 4 compares the rankings in 1991 and 2004 for four spending categories. The ranking of states by per enrollee Medicare spending reveals the greatest degree of persistence over time. The correlation coefficient between the 1991 and 2004 rankings is 0.88. Louisiana and Maryland are persistently at the top of the rankings (sorted lowest to highest) while South Dakota and Montana are found at the lower end of the rankings at the beginning and end of the sample period. The correlation coefficient between the 1991 and 2004 rankings of per capita personal health care and Medicaid per enrollee are similar at 0.62 and 0.63, respectively. Importantly, we see that the lowest correlation for the non-Medicare or Medicaid population between 1991 and 2004 was only 0.35, indicating that this segment of the health care market is the most dynamic. This dynamism can be attributed to changes in the underlying population of health care consumers as well as to the market conditions that may produce more mobility in this largely nongovernment payer part of the market. In the next

section, we explore how these observations hold up once we adjust for some of the causes of mobility.

Table 2 presents the correlation coefficients along with the adjusted R^2 from the simple regression where the state rank in 1991 is used to explain the rank in 2004 for measures depicted in Figure 4 along with the other measures considered previously. The R^2 indicates the degree of the variation in the 2004 rank that is explained by the 1991 rank. As the table shows, the 1991 rankings in the Medicare distribution explain 77 percent of the variation in the 2004 rankings. In contrast, the same comparison based on spending by the non-Medicare/Medicaid population only explains 10 percent of the variation. This confirms the persistence in the Medicare rankings compared to the relative dynamism in spending by the nongovernment payer segment.

Effects of State Characteristics on Health Care Spending

In the appendix, we present the state specific variables we use to explain health care spending. State health care spending is expected to depend on the population age, sex and racial composition. Further, income and education will affect spending levels. The underlying health of the state's population and the wages paid in the health sector will also influence spending. Finally, the percent of the population that is uninsured will naturally affect this group's spending. But because the percent of a state's population that is uninsured is contingent on the generosity of Medicaid, we also account for this interaction in the statistical estimation procedure. Specifically, we treat the uninsured percent as endogenous and explain its variation with a set of instrumental variables: the percent of the working age population that is employed, the federal Medicaid matching percentage (to control for the generosity of Medicaid by state) and the

Democratic percentage of the U.S. House delegation. Summary statistics for each of the variables in 2004 are presented in Table A-1.

Given that the data span the fourteen years from 1991 to 2004 for the panel of 50 states, we estimate both cross-sectional and the time series effects of the variables on health care spending. We limit the spending variables explained by the control variables to per capita health care spending, Medicare per enrollee spending and per capita spending by the non-Medicare/Medicaid population. The same set of variables is used to explain each of these spending variables. Appendix Tables A-2 to A-4 presents the estimation results for three different models: the pooled model, the model that controls for state fixed effects and the between model. The last model in each table reflects the cross-sectional regression on the state averages over the entire time period and is similar conceptually to the cross-sectional regression on a single year of data often used in this literature. In this particular exercise, we have fewer state observations, 50, than in a previous study (Hopson and Rettenmaier (2008)) using county level data and fewer than the articles in the literature using HRR data (Skinner and Fisher (1997) and Cutler and Sheiner (1999)). However, as mentioned earlier, the advantage of the current data is the ability to expand the analysis beyond Medicare spending and to also explore the effect of the uninsured rate on each health care spending measure.

Table 3 summarizes the results based on the between model estimates when the three different spending variables are considered. States with higher nontransfer income, higher income maintenance payments, higher retirement age percentages and higher "bad health" index values (the interaction between the percent of the population that currently smokes and the percent obese) have higher per capita health care spending. The percent of the population that is uninsured has a negative effect on per capita spending, as expected, but the effect is insignificant

in this model, though it is negative and significant for the pooled and within models presented in Table A-2.

The results when Medicare spending per enrollee is the dependent variable are presented in the next two columns of Table 3. In this case, the percent of the population less than the age of 65 that is uninsured increases Medicare spending per capita. This indicates the Medicare cross-subsidizes the uninsured population.[11] Higher nontransfer income and higher income maintenance income are also associated with higher Medicare spending per enrollee. See Appendix Table A-3 for the pooled and within model coefficient estimates.

The final two columns present the between model's results when average spending by the non-Medicare/Medicaid population is the dependent variable. In this case, the percent of the population that is uninsured has a negative and significant effect on spending and the bad health index has a positive and marginally significant effect. In the next section, we estimate the potential savings that can result by constraining spending to the 10th percentile in the raw distribution and then in the distribution that takes into account the effects of state specific variables on spending.

Potential Saving for Hypothetical Expenditure Limit

This section identifies by how much health care spending would be reduced in a hypothetical calculation that constrains spending to the spending at the 10th percentile in raw distribution and in the distribution that controls for observable state difference. This exercise is

[11] The anecdotal evidence would suggest that the uninsured increase Medicare's expenditures by increasing hospital emergency room visits. We also explore whether the uninsured percentage increases Medicare's expenditures primarily through hospitalization expenditures or Medicare's non hospital spending. Interestingly, the effect is greater on the non hospital spending components. Considering the state average disproportionate share percentage (available from 1994-2004) as an additional IV control produces similar results in the Medicare regressions.

similar in spirit to the estimates reported by Cutler and Sheiner (1999). Figure 5 reports the results of this hypothetical calculation in each year for all personal health care, Medicare and for the non-Medicare/Medicaid segment of the population. The unadjusted series in each panel is simply the percent by which total national spending would be reduced if per capita spending was constrained to the spending at the 10th percentile in the state spending distribution. Total overall health care spending could be reduced about 14 percent in each year by constraining spending to the level at the 10th percentile. Total national Medicare spending would be reduced by 24 percent with the hypothetical restriction.[12] This greater reduction is in large part due to the fact that the many of the higher spending states in the Medicare distribution are also the more populous states, like Florida, Texas, New York and California. Total national spending for the non-Medicare/Medicaid population would be reduced by about 13 percent on average in each year.

Once observable differences in each state are accounted for, potential savings are reduced. Formally, the adjusted series is obtained by first running a cross-section instrumental variable regression for each year and determining the 10th percentile in the residual distribution. This residual is added to the predicted spending in each state and then the population weighted annual total is calculated. The difference between actual total and this constrained total determines potential savings. The adjusted potential savings is about 5 percent per year for all personal health care, the adjusted savings average about 10 percent per year for Medicare and about 8 percent per year for the non-Medicare/Medicaid segment of the health care market.

[12] This reduction is similar in size to the 30 percent estimated by Cutler in Sheiner, *AER*, May 1999. It is important to note, however, that the present study uses unadjusted state level data while their estimate is based on the Dartmouth data at the Hospital Referral Region level that was adjusted for differences in age, sex, race and price.

These results indicate that the potential spending reduction is highest for Medicare, though the adjusted reduction is only 10 percent of total spending.[13]

As an aside, the residuals in each year from each regression can also be analyzed to determine the degree to which the persistence noted in Figure 4 and recorded in Table 2 is a result of persistent observable characteristics of the population and the degree to which it is due to unobserved state differences. The correlation coefficients between the 1991 and 2004 residuals from the average personal health care, Medicare and non-Medicare/Medicaid regressions are 0.33, 0.36 and 0.16, respectively, indicating that persistence in unobserved state characteristic (i.e. practice styles, other unobserved health risks, etc.) has the greatest effect in the Medicare segment of the market.

Conclusion

One of the perceived indicators of the health care system's inefficiency is the existence of the dramatic variation in spending in different areas of the country coupled with the observation that health outcomes in higher spending areas are not necessarily better than outcomes in the lower cost areas. Thus, adoption of the health care practice styles that exist in the low cost regions of the country has been mentioned as one way to reduce health care spending and increase efficiency.

Geographic variation is often identified by the variation in Medicare spending and this variation is implicitly assumed to hold in all others components of health care. However, as we have seen, there are numerous ways to think about geographic variation in health care spending

[13] Again using Cutler in Sheiner, *AER*, May 1999, as a point of reference, the average adjusted reduction of 10 percent is lower than their estimated reduction of 15 percent.

and each would identify different high or low cost areas. We also saw that persistence in spending over time is most prevalent in Medicare spending.

Some of the geographic variation can be explained by differences in the demographic characteristics of the population and by health care market characteristics. Thus, other factors are clearly at play that have produced persistently high or low spending in some areas or the country. In addition to demographic, income, health risks and market conditions, the percent of the population that is uninsured was also considered as one of the explanatory variables. As expected, a higher uninsured rate is associated with lower state health care spending in the non-Medicare/Medicaid population. In contrast, a higher percent of the population with no insurance resulted in higher Medicare spending per enrollee indicating cost shifting to Medicare.

Hypothetical potential savings resulting from reducing spending to the 10^{th} percentile in the distribution of spending was calculated in each year using both the raw distribution and then adjusting for the state characteristics. This exercise shows that the potential savings are greatest in the Medicare sector, but the savings are more than halved when state characteristics are considered. Further, the same experiment when the other measures of spending are considered yield much smaller potential unadjusted and adjusted savings.

This study carries important policy implications. It has been argued that if all areas in the United States had the level of spending prevailing in the relatively low spending areas, Medicare spending would fall by a significant amount and an opportunity for improving the program's funding problem emerges. This is indeed true of Medicare where the potential savings is greatest. However, where to go to find the low cost / high quality areas of the country to emulate is specific to the population segments - Medicare, Medicaid and the non-Medicare/Medicaid –

being considered. The bottom line is that the policy prescriptions, if applied nationwide across all health care consumer populations, must be more nuanced than the prescriptions emerging from observations based the Medicare segment of the market in isolation.

Table 1

Rank Correlation Coefficients in Unadjusted 2004 for Health Care Spending Measures

	Medicare per enrollee	Personal health care per capita	Medicaid per enrollee	Medicaid enrollees as a % of the population	Per capita health care by non-Medicare/Medicaid population	Personal health care spending as a % of personal income
Medicare per enrollee	1.000					
Personal health care per capita	0.210	1.000				
Medicaid per enrollee	-0.015	0.655	1.000			
Medicaid enrollees as a % of the population	0.201	0.041	-0.495	1.000		
Per capita health care by non-Medicare/Medicaid population	-0.172	0.820	0.505	-0.069	1.000	
Personal health care spending as a % of personal income	-0.137	0.412	0.060	0.440	0.291	1.000

Table 2

Rank Correlation Coefficients Between Rank in 1991 and Rank in 2004
for Health Care Spending Measures

	Correlation Coefficient	Adjusted R^2
Medicare per enrollee	0.88	0.77
Personal health care per capita	0.62	0.37
Medicaid per enrollee	0.63	0.39
Medicaid enrollees as a % of the population	0.79	0.61
Per capita health care by non-Medicare/Medicaid population	0.35	0.10
Personal health care spending as a % of personal income	0.71	0.50

Table 3
Parameter Estimates from Between Models
(percent uninsured is treated as endogenous)

	Personal Health Care Spending – all residents		Medicare Spending per enrollee		Personal Health Care Spending – non-Medicare/Medicaid Population	
Variable	Coef	t	coef	T	Coef	t
percent uninsured <65 years old	-27.473	-1.31	83.055	2.43	-41.558	-2.15
per capita nontransfer income	0.075	3.00	0.101	2.49	0.030	1.32
per capita income maintenance	2.332	4.26	1.978	2.21	0.706	1.40
percent retirement age	95.683	3.20	38.367	0.79	32.782	1.19
percent female	-58.243	-0.42	255.334	1.14	-182.623	-1.44
percent black	-1.621	-0.25	15.360	1.43	-0.240	-0.04
percent other	-7.214	-1.19	-7.037	-0.71	-0.975	-0.17
percent high school grad	5.039	0.23	33.839	0.93	-8.057	-0.39
percent college grad	15.508	0.50	45.571	0.90	6.029	0.21
bad health index	145.180	1.79	183.448	1.39	124.849	1.67
health sector wage	-0.010	-0.64	0.032	1.26	-0.002	-0.11
constant	2661	0.31	-17924	-1.28	11163	1.41
Observations	700		700		700	
R^2 within	0.8897		0.8870		0.7280	
R^2 between	0.7617		0.7810		0.5901	
R^2 overall	0.8179		0.8477		0.6410	

Figure 1

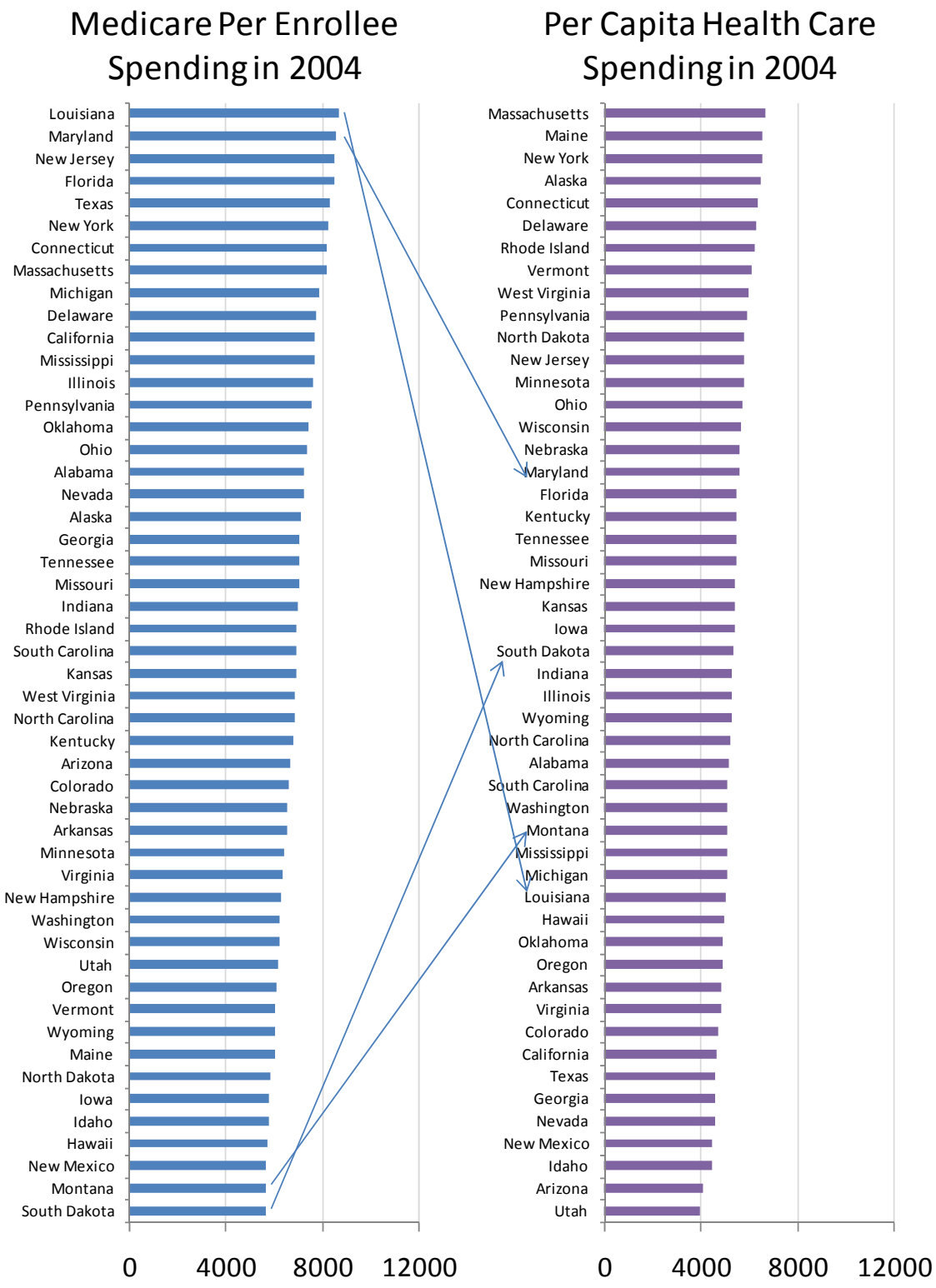

Medicare Per Enrollee Spending in 2004
Louisiana
Maryland
New Jersey
Florida
Texas
New York
Connecticut
Massachusetts
Michigan
Delaware
California
Mississippi
Illinois
Pennsylvania
Oklahoma
Ohio
Alabama
Nevada
Alaska
Georgia
Tennessee
Missouri
Indiana
Rhode Island
South Carolina
Kansas
West Virginia
North Carolina
Kentucky
Arizona
Colorado
Nebraska
Arkansas
Minnesota
Virginia
New Hampshire
Washington
Wisconsin
Utah
Oregon
Vermont
Wyoming
Maine
North Dakota
Iowa
Idaho
Hawaii
New Mexico
Montana
South Dakota
0
4000
8000
12000
Per Capita Health Care Spending in 2004
Massachusetts
Maine
New York
Alaska
Connecticut
Delaware
Rhode Island
Vermont
West Virginia
Pennsylvania
North Dakota
New Jersey
Minnesota
Ohio
Wisconsin
Nebraska
Maryland
Florida
Kentucky
Tennessee
Missouri
New Hampshire
Kansas
Iowa
South Dakota
Indiana
Illinois
Wyoming
North Carolina
Alabama
South Carolina
Washington
Montana
Mississippi
Michigan
Louisiana
Hawaii
Oklahoma
Oregon
Arkansas
Virginia
Colorado
California
Texas
Georgia
Nevada
New Mexico
Idaho
Arizona
Utah
0
4000
8000
12000

Figure 2

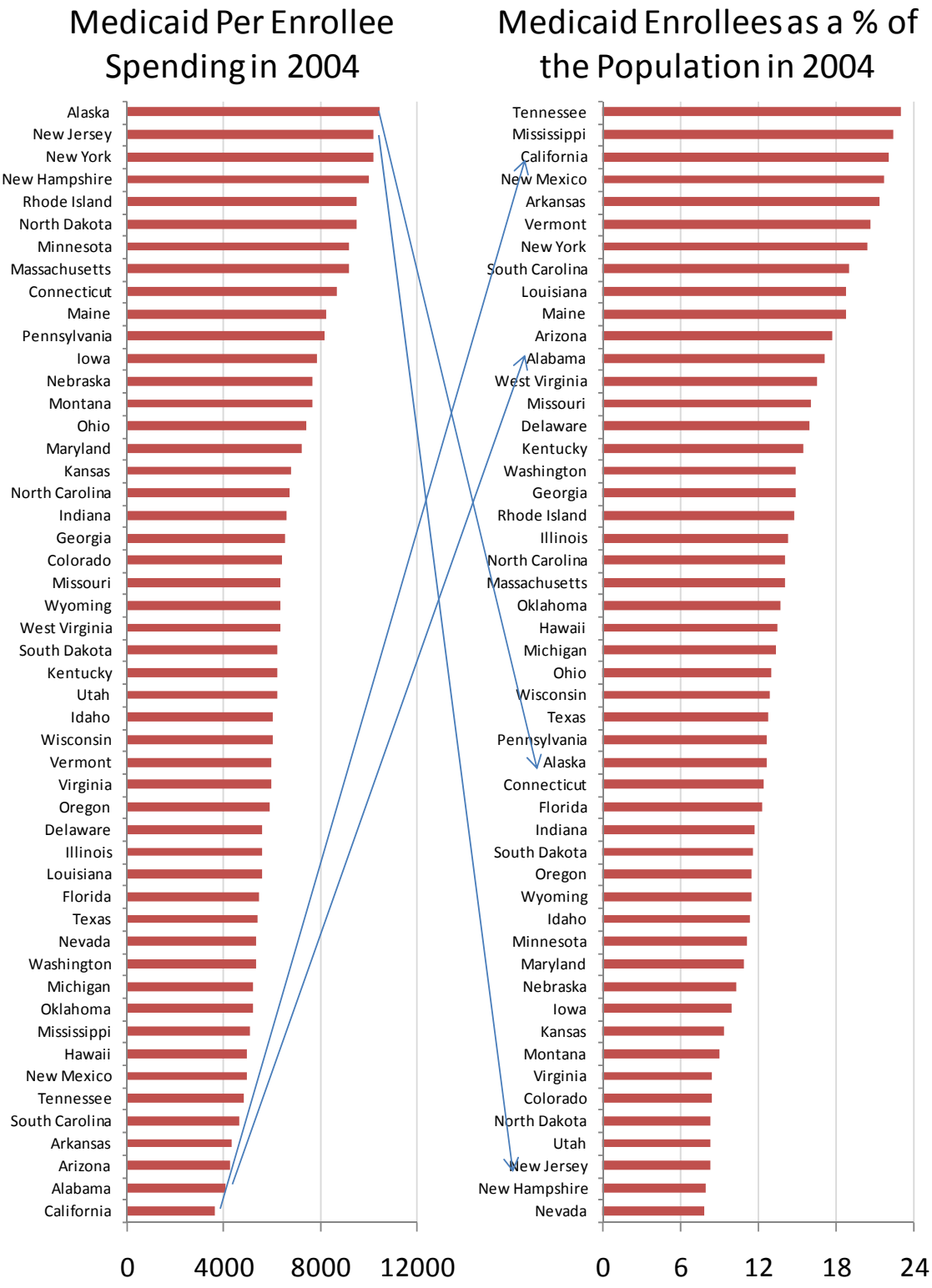

Medicaid Per Enrollee Spending in 2004
Alaska
New Jersey
New York
New Hampshire
Rhode Island
North Dakota
Minnesota
Massachusetts
Connecticut
Maine
Pennsylvania
Iowa
Nebraska
Montana
Ohio
Maryland
Kansas
North Carolina
Indiana
Georgia
Colorado
Missouri
Wyoming
West Virginia
South Dakota
Kentucky
Utah
Idaho
Wisconsin
Vermont
Virginia
Oregon
Delaware
Illinois
Louisiana
Florida
Texas
Nevada
Washington
Michigan
Oklahoma
Mississippi
Hawaii
New Mexico
Tennessee
South Carolina
Arkansas
Arizona
Alabama
California
0
4000
8000
12000
Medicaid Enrollees as a % of the Population in 2004
Tennessee
Mississippi
California
New Mexico
Arkansas
Vermont
New York
South Carolina
Louisiana
Maine
Arizona
Alabama
West Virginia
Missouri
Delaware
Kentucky
Washington
Georgia
Rhode Island
Illinois
North Carolina
Massachusetts
Oklahoma
Hawaii
Michigan
Ohio
Wisconsin
Texas
Pennsylvania
Alaska
Connecticut
Florida
Indiana
South Dakota
Oregon
Wyoming
Idaho
Minnesota
Maryland
Nebraska
Iowa
Kansas
Montana
Virginia
Colorado
North Dakota
Utah
New Jersey
New Hampshire
Nevada
0
6
12
18
24

Figure 3

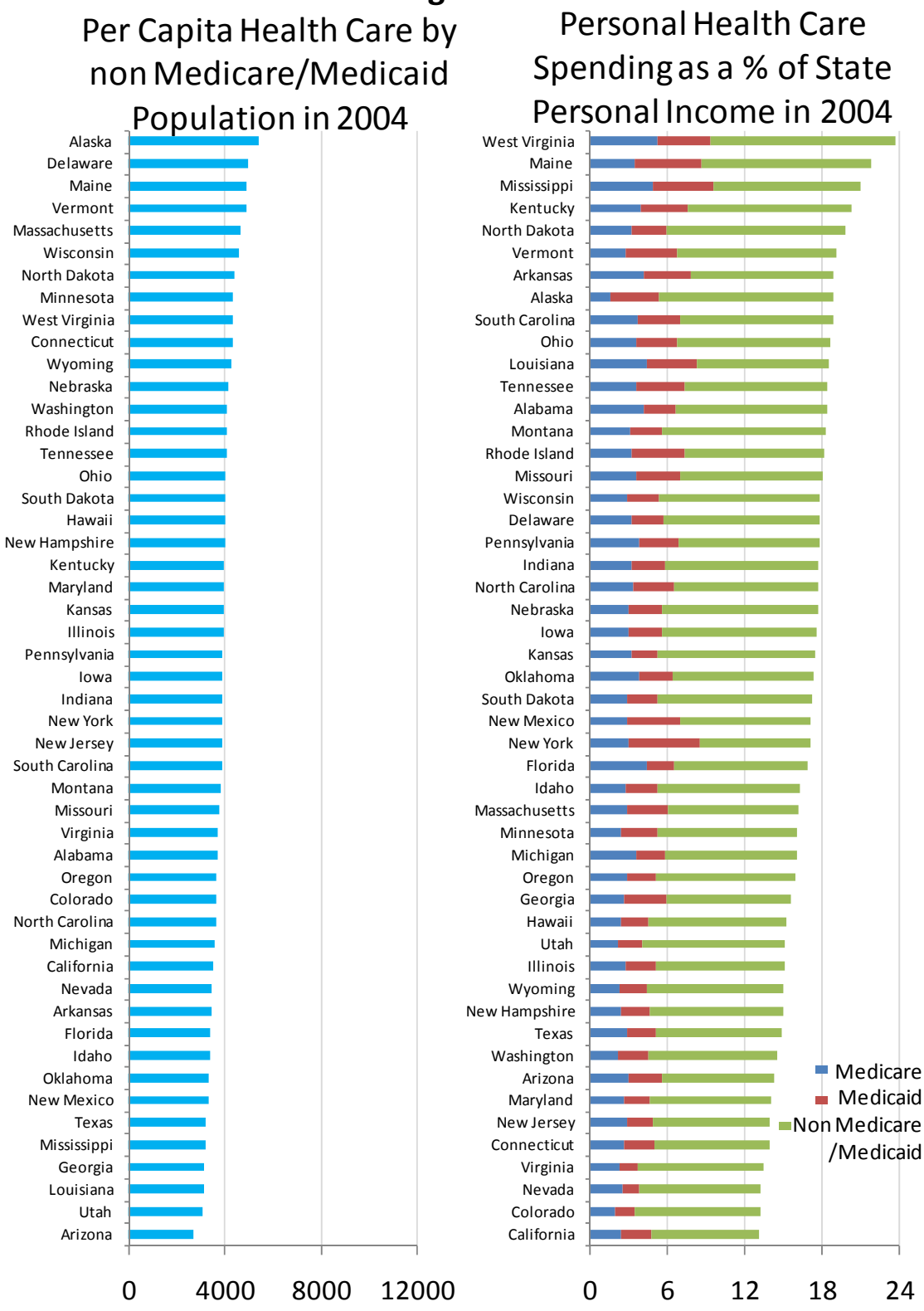

Per Capita Health Care by non Medicare/Medicaid Population in 2004
Alaska
Delaware
Maine
Vermont
Massachusetts
Wisconsin
North Dakota
Minnesota
West Virginia
Connecticut
Wyoming
Nebraska
Washington
Rhode Island
Tennessee
Ohio
South Dakota
Hawaii
New Hampshire
Kentucky
Maryland
Kansas
Illinois
Pennsylvania
Iowa
Indiana
New York
New Jersey
South Carolina
Montana
Missouri
Virginia
Alabama
Oregon
Colorado
North Carolina
Michigan
California
Nevada
Arkansas
Florida
Idaho
Oklahoma
New Mexico
Texas
Mississippi
Georgia
Louisiana
Utah
Arizona
0
4000
8000
12000
Personal Health Care Spending as a % of State Personal Income in 2004
West Virginia
Maine
Mississippi
Kentucky
North Dakota
Vermont
Arkansas
Alaska
South Carolina
Ohio
Louisiana
Tennessee
Alabama
Montana
Rhode Island
Missouri
Wisconsin
Delaware
Pennsylvania
Indiana
North Carolina
Nebraska
Iowa
Kansas
Oklahoma
South Dakota
New Mexico
New York
Florida
Idaho
Massachusetts
Minnesota
Michigan
Oregon
Georgia
Hawaii
Utah
Illinois
Wyoming
New Hampshire
Texas
Washington
Arizona
Maryland
New Jersey
Connecticut
Virginia
Nevada
Colorado
California
0
6
12
18
24
Medicare
Medicaid
Non Medicare /Medicaid

Figure 4

Persistence in Health Care Spending Rankings over Time

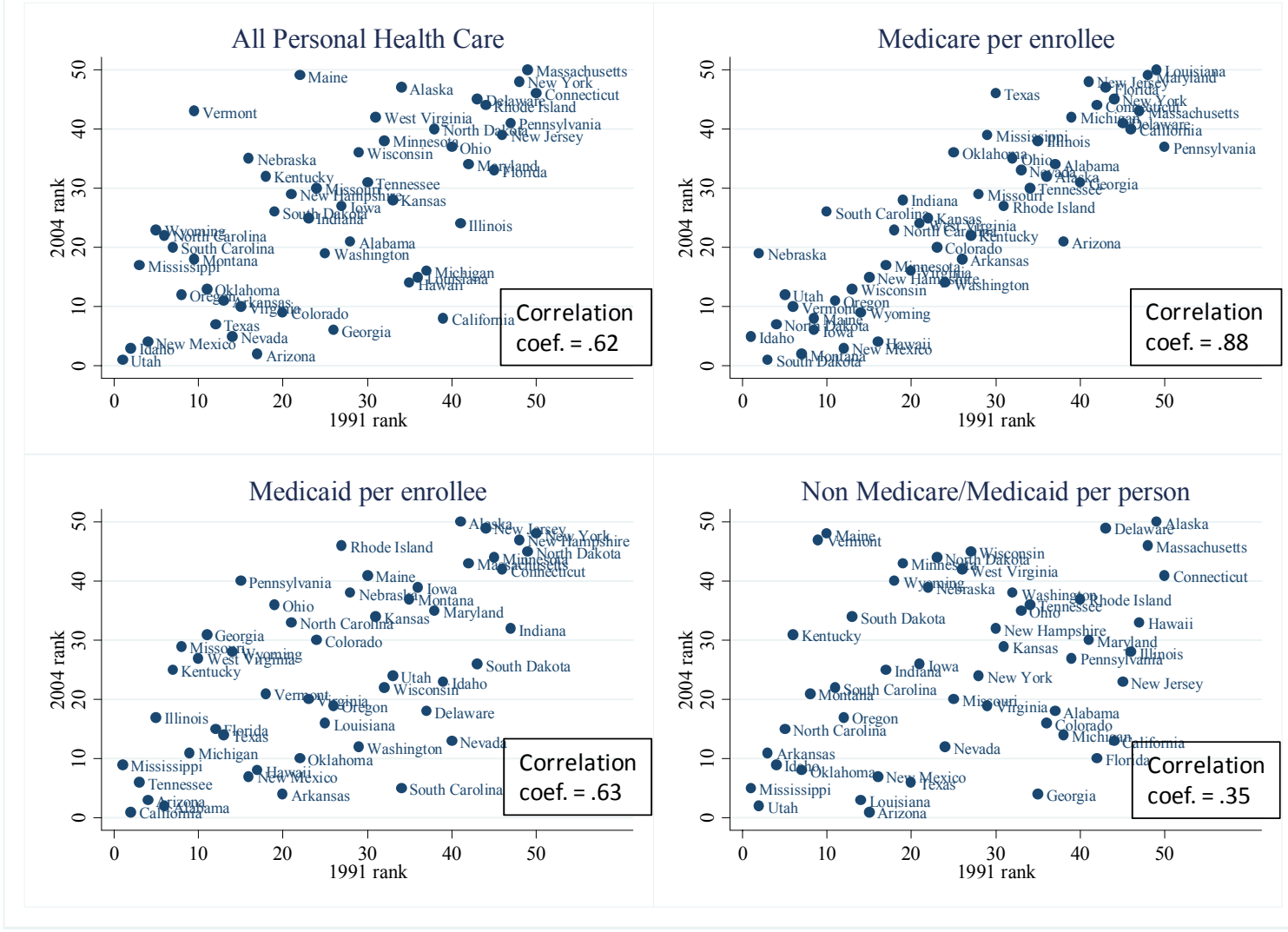
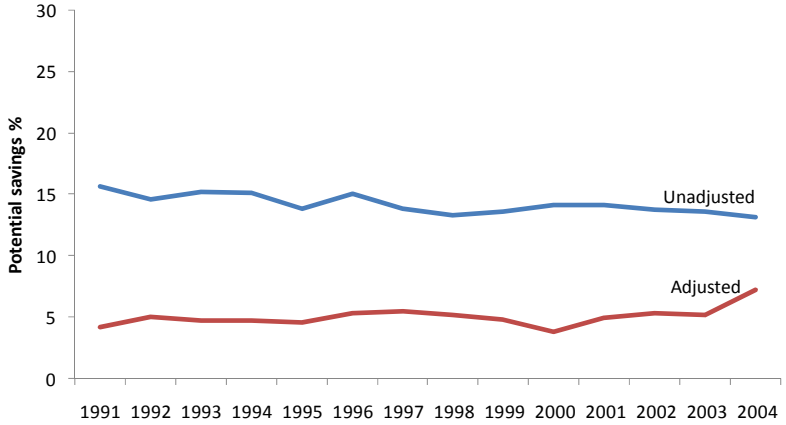


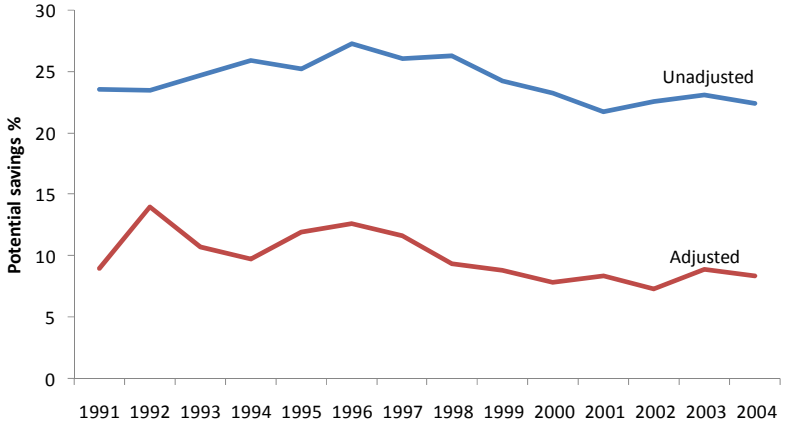
Figure 5

Potential Savings if Spending is Restricted to 10th Percentile

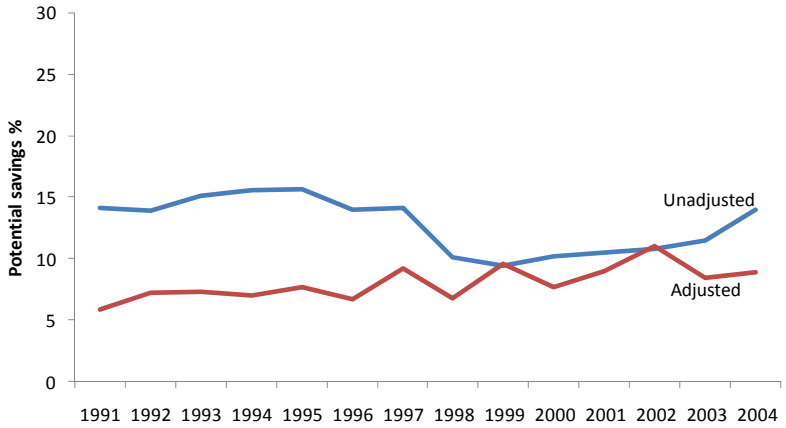
All Personal Health Care



Medicare



Non Medicare or Medicaid



Appendix

Data Sources

Dependent variables

Per capita health care spending - state of residence (1991-2004) (CMS)

Medicare spending per enrollee - state of residence (1991-2004) (CMS)

Per capita health spending by non-Medicare/Medicaid enrollees - state of residence (1991-2004) (CMS – authors' estimates (see footnote 10))

Independent variables

per capita nontransfer income (Bureau of Economic Analysis (BEA))

per capita income maintenance (BEA)

percent retirement age (Census)

percent female (Census)

percent black (Census)

percent other (Census)

percent high school grad (Current Population Survey)

percent college grad (Current Population Survey)

bad health index (percent current smoker x percent obese) (CDC)

health sector wage (BEA)

percent uninsured <65 years (Census / CPS)

Instrumental variables in the uninsured regression

percent of working age population employed (BEA and Census)

federal Medicaid matching percentage (CMS)

Democratic percent of US House delegation (Census / Stat Abstract)

Disproportionate Share (CMS) available 1994-2004

Description of State of Residence File

State of residence personal health care spending per capita and Medicare spending per enrollee are from the Center's for Medicare and Medicaid Services (CMS) State Health Expenditure Accounts, by state of residence. The per capita health spending by non-Medicare/Medicaid enrollees derived from the state of residence accounts is described in footnote 10. Given that the quality of the state of residence data for the per capita health care spending variable has been questioned by Skinner, et al. in *Health Affairs* 28, No. 1(2009) w119-w123, a discussion of the data is warranted.

The state of residence data file is available on the CMS's website along with a data description.

http://www.cms.hhs.gov/NationalHealthExpendData/05_NationalHealthAccountsStateHealthAccountsResidence.asp#TopOfPage.

As mentioned, a survey of the data and additional information about its construction and its compatibility of the National Health Expenditure Accounts is available in Anne B. Martin, Lekha Whittle, Stephen Heffler, Mary Carol Barron, Andrea Sisko and Benjamin Washington, "Health Spending by State of Residence, 1991-2004," *Health Affairs,* September 18, 2007.

The National Health Expenditure Accounts (NHEA), on which the state of residence data is based, is the government's official accounting of health care spending by source of funds and by category of spending. The NHEA documentation is available at: http://www.cms.hhs.gov/NationalHealthExpendData/downloads/dsm-07.pdf

The state of residence file is constructed by adjusting the state of provider file using border-crossing flow patterns. The state of provider file and documentation is available at: http://www.cms.hhs.gov/NationalHealthExpendData/05a_NationalHealthAccountsStateHealthAccountsProvider.asp#TopOfPage.

The state of residence file is consistent with the NHEA in terms of methodology and the totals by state of residence add up to the NHEA estimates at the national level of aggregation.

The issues raised by Skinner, et al. (2009) in regards to the state of residence data set are two-fold. Their concerns about the data set are set in the context of a critic of a paper by Richard A. Cooper, "States with More Physicians Have Better-Quality Health Care," *Health Affairs* Vol. 28, No. 1 (2009). Cooper's (2009) work suggested that there exists a positive correlation between health care quality and total spending, based on the state of resident file used here. This finding is in contrast to the well established findings of the Dartmouth group that higher health care spending is not associated with higher quality. They note that an additional control for observable differences in a state's age structure makes Cooper's finding of a positive correlation insignificant. On this first point, namely, the findings based on the Dartmouth Medicare data, that there is little or no relationship between spending and quality is fully accepted.

However, the second concern raised by Skinner et al. (2009) involves the reliability of the state of residence file that is used in the current analysis. In particular, they take issue with the estimate of the per capita personal health care spending by state of residence. This concern basically challenges how well CMS allocates the national aggregate NHEA measures to the states. But before we address this concern, it is important to note the similarity in the distributions of Medicare spending, based on the *Dartmouth Atlas* and based on the CMS state of residence file. The correlations coefficient between these Medicare spending estimates per

enrollee is 0.93 in 2004, the last year of the CMS data. This indicates that the two data sources generally rank the same states from low to high spending. The CMS Medicare data includes both disabled and aged Medicare enrollees in both fee-for-service Medicare and manage care programs. Given that the *Dartmouth Atlas* Medicare data are adjusted for age, race and sex, and the sample is restricted to nonmanaged care enrollees who are 65 and above, it is not surprising that the correlation is less than 1.[14]

Medicaid spending in the state of residence file is from the Medicaid State Financial Management Reports. The Medicaid data are from the state of provider file on the assumption that Medicaid patients receive their care within state. (See the links above for further documentation.) Because the Medicaid estimates are from administrative data, they should also reliably represent such spending in the state. As noted in the body of the paper, these data indicate that per enrollee Medicare and Medicaid are inversely related.

If Medicare and Medicaid spending are reliably represented at the state level in CMS data, and because the state totals for both programs sum to the totals in the NHEA, then the concern expressed by Skinner et al. (2009) regarding the reliability of overall average health care spending in the states calls into question how well the national total personal health care spending is distributed to the states. The distribution to the states is based in large part on the private sector services accounted for in the North American Industrial Classification System (NAICS) under the category Health Care and Social Assistance (NAICS 62). The documentation for the NHEA provides a detailed discussion of how these and other data are used to develop aggregate health care spending. The Bureau of Economic Analysis also provides the same NAICS data at the state level and this forms the foundation for the state of provider

[14] When the *Dartmouth Atlas* state average Medicare data for 2004 is compared to the unadjusted state average Medicare FFS data for the 65 and above population used in Hopson and Rettenmaier (2008) the correlation coefficient is 0.96.

aggregates. Appendix Figure 1 illustrates the consistency between the allocations of total personal health care spending to the individual states based on the state of residence file and based on the distribution of total Health Care and Social Assistance (NAICS 62) among the states for 2004. As the figure shows the allocations are essentially the same. Though a state's shares of NAICS 62 is only a rough approximation of the appropriate distribution, this simple comparison suggests that the allocations of total spending to the states via the methodology described in the three sets of CMS documentation provides reliable estimates of state per capita personal health care spending.

Skinner et al. (2009) argue the Medicare spending and non-Medicare spending should be similarly distributed across the states and question the resorting that is evident in the state of residence data. They suggest that cost of living, illness levels and practice patterns are common within the states would lead to similar spending per capita by the population above and below 65. However, because the populations above and below 65 face do not face the same constraints when it comes to consuming health care, it is not surprising that significant resorting occurs in the ranking of states based on the population subsets given different Medicaid coverage rates, uninsured rates and income levels.

Table A-1

Dependent and Independent Variable Averages of State Values in 2004

Variable	Mean	Min	Max
Per capita personal health care	$5,350.92	$3,972.00	$6,683.00
Medicare per enrollee	$6,938.68	$5,640.00	$8,659.00
Per capita by non-Medicare/Medicaid enrollees	$2,964.82	$1,815.00	$4,598.00
per capita nontransfer income	$27,204.58	$18,795.00	$40,501.00
per capita income maintenance	$444.32	$234.00	$718.00
percent retirement age	12.57	6.39	16.92
percent female	50.70	48.30	51.7
percent black	10.75	0.76	36.69
percent other	6.60	1.42	64.11
percent high school grad	59.66	49.60	69.40
percent college grad	26.80	15.30	36.70
bad health index	5.01	2.14	7.42
health sector wage	$46,767.92	$39,596.45	$56,576.32
percent uninsured <65 years	16.13	9.90	27.40
percent of working age population employed	80.02	63.22	94.63
federal matching percentage	60.79	50.00	77.08
Democratic percent of U.S. House delegation	43.18	0.00	100.00

Table A-2
Parameter Estimates from Pooled, Within and Between Models
[Dependent variable is per capita personal health care spending]
(percent uninsured is treated as endogenous)

	pooled model		within model		between model	
Variable	coef	t	coef	t	coef	t
percent uninsured <65 years old	-36.760	-5.05	-147.779	-2.26	-27.473	-1.31
per capita nontransfer income	0.055	8.11	-0.030	-1.56	0.075	3.00
per capita income maintenance	2.398	13.22	1.750	3.53	2.332	4.26
percent retirement age	92.614	9.45	108.781	1.94	95.683	3.20
percent female	-56.732	-1.47	227.178	1.78	-58.243	-0.42
percent black	-2.260	-0.98	29.352	0.56	-1.621	-0.25
percent other	-11.505	-5.78	13.545	0.46	-7.214	-1.19
percent high school grad	1.549	0.40	-2.426	-0.52	5.039	0.23
percent college grad	4.077	0.67	-19.960	-1.70	15.508	0.50
bad health index	51.640	2.51	-111.856	-2.18	145.180	1.79
health sector wage	0.013	3.00	0.112	9.53	-0.010	-0.64
year	108.249	14.59	121.216	4.38		
constant	-213032	-14.97	-252474	-4.42	2661	0.31
Observations	700		700		700	
R^2 within			0.8758		0.8897	
R^2 between			0.3483		0.7617	
R^2 overall	0.8974		0.6254		0.8179	

Table A-3
Parameter Estimates from Pooled, Within and Between Models
[Dependent variable is per capita Medicare Spending]
(percent uninsured is treated as endogenous)

	pooled model		within model		between model	
Variable	coef	t	coef	t	coef	t
percent uninsured <65 years old	73.751	6.96	108.019	1.70	83.055	2.43
per capita nontransfer income	0.096	9.76	0.033	1.79	0.101	2.49
per capita income maintenance	2.460	9.32	4.754	9.87	1.978	2.21
percent retirement age	54.224	3.80	-67.420	-1.24	38.367	0.79
percent female	119.151	2.12	-158.006	-1.28	255.334	1.14
percent black	18.160	5.41	130.527	2.56	15.360	1.43
percent other	-12.942	-4.46	-14.782	-0.52	-7.037	-0.71
percent high school grad	14.030	2.50	-0.866	-0.19	33.839	0.93
percent college grad	27.498	3.12	18.423	1.61	45.571	0.90
bad health index	96.153	3.21	-52.323	-1.05	183.448	1.39
health sector wage	0.029	4.55	0.005	0.47	0.032	1.26
year	82.485	7.64	152.293	5.66		
constant	-173790	-8.39	-296046	-5.33	-17924	-1.28
Observations	700		700		700	
R^2 within			0.9227		0.8870	
R^2 between			0.4646		0.7810	
R^2 overall	0.8765		0.5638		0.8477	

Table A-4
Parameter Estimates from Pooled, Within and Between Models
[Dependent variable is per capita non-Medicare/Medicaid personal health care spending]
(percent uninsured is treated as endogenous)

	pooled model		within model		between model	
Variable	coef	t	coef	t	coef	t
percent uninsured <65 years old	-48.963	-6.59	-98.479	-1.91	-41.558	-2.15
per capita nontransfer income	0.011	1.58	-0.033	-2.19	0.030	1.32
per capita income maintenance	0.846	4.57	0.583	1.49	0.706	1.40
percent retirement age	26.426	2.64	136.400	3.09	32.782	1.19
percent female	-139.599	-3.54	151.018	1.50	-182.623	-1.44
percent black	-1.447	-0.61	0.255	0.01	-0.240	-0.04
percent other	-4.715	-2.32	20.466	0.89	-0.975	-0.17
percent high school grad	-2.791	-0.71	-2.439	-0.67	-8.057	-0.39
percent college grad	-1.406	-0.23	-13.875	-1.50	6.029	0.21
bad health index	30.664	1.46	-81.738	-2.02	124.849	1.67
health sector wage	0.024	5.31	0.123	13.36	-0.002	-0.11
year	97.635	12.89	57.185	2.62		
constant	-186167	-12.82	-122888	-2.73	11163	1.41
Observations	700		700		700	
R^2 within			0.8654		0.7280	
R^2 between			0.1895		0.5901	
R^2 overall	0.8089		0.5179		0.6410	

Appendix Figure 1

Comparing Alternative Estimates of States' Shares of National Total Health Care Spending