

An Investigation of the Relationship between Health Care Costs and Premiums by State



UNIVERSITY OF WISCONSIN- EAU CLAIRE | ACTUARIAL SCIENCE

Shawny Jo Gabriel
Faculty Collaborator: Herschel E. Day

INTRODUCTION

The focus of this project was to determine how closely related health insurance costs and premiums were across the 50 states in the 2014 Individual market. Significant changes were brought to this market in 2014 with many major elements (e.g., no gender rating, 3:1 age limit on premiums, guaranteed issue, etc.) of the Affordable Care Act finally becoming effective. While we expected to find that general cost differences among states translated directly to premium differentials, there was clear evidence suggesting otherwise. For example, the state of Minnesota had the second lowest 2014 exchange premiums while having per capita health care costs that ranked in the highest 30% of states. Using regression analysis and age/gender normalization, we examined publicly available data to better understand the relationship of health care costs and premiums.

METHODS

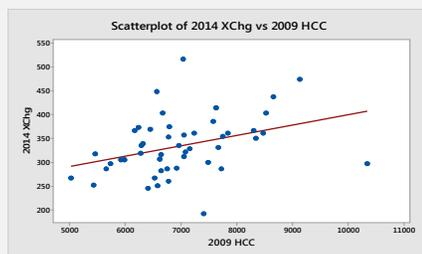
In order to analyze the cost-premium relationship in the Individual market exchanges, we searched publicly available datasets containing relevant variables for this study. Our two primary sources of data were the National Health Expenditures (NHE) as published by the Centers for Medicare and Medicaid Services (CMS) and the Health plan data for 2014 through 2015 from www.healthcare.gov.

Due to limitations posed by the public datasets, advanced statistical techniques were too difficult to be incorporated into our analysis. Instead, we decided to employ more simplistic analysis methods in the hopes that such methods would still provide valuable insight into the relationship between costs and premiums.

ANALYSIS

INITIAL DATASET

We first analyzed the relationship between the NHE and 2014 Individual market exchange premiums for 47 states and the District of Columbia. States that were excluded (Hawaii, Massachusetts, and Kentucky) had state-based exchanges in 2014 for which premiums were not easily obtainable. A scatterplot illustrating the relationship between costs ("2009 HCC") and exchange premiums ("2014 XChg") is shown below:



Two measures that are generally of statistical interest when performing a linear regression are the linear correlation coefficient, r , and the coefficient of determination, R^2 . The former measures the strength and direction of the linear relationship between two quantitative variables, while the latter measures the percentage of total variation in the explanatory variable (in this case, 2014 exchange premiums) that is explained by the least-squares regression line. Our initial model yielded $r = 0.356$ and $R^2 = 12.7\%$, suggesting that the linear relationship between costs and premiums was relatively weak.

OUTLIERS

The previous scatterplot and accompanying residual plot indicate that there were a few outliers in the dataset that could have significantly influenced the statistical analysis of this relationship. Namely, there were two observations with unusually large positive residuals and two observations with unusually large negative residuals:

State	Actual 2014 Individual Market Exchange Premium	Predicted 2014 Individual Market Exchange Premium	Residual
Wyoming	\$516	\$335	\$181
Mississippi	\$448	\$325	\$123
Minnesota	\$192	\$343	(\$151)
District of Columbia	\$297	\$406	(\$109)

In an attempt to immunize the statistical analysis from these influential observations, we removed these three states and the District of Columbia from our data and conducted the same analysis again. The resulting least-squares regression provided the following output:

Regression Analysis: 2014 XChg versus 2009 HCC

Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
40.61	38.68%	37.22%	32.76%

Regression Equation

$$2014 \text{ XChg} = 93.8 + (0.03430 * 2009 \text{ HCC})$$

The R^2 value of 38.9% is a marked improvement over the original R^2 of 12.7%. The same can be said of the linear correlation coefficient which increased to 0.624 from 0.356. While the removal of the outliers revealed a much stronger relationship between costs and premiums, we still noted that much of the variation in exchange premiums was unexplained after consideration of the cost levels by state.

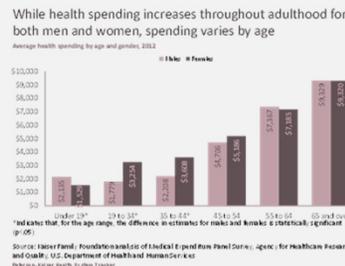
NORMALIZATION

One of the shortcomings we identified with the analysis above is that the state exchange premium information was based on a standard population whereas the NHE data reflected differences in age/gender composition by state. To attempt to account for this, we went through a process of normalizing the NHE values by state to remove differences due to the age/gender composition.

The table below shows a breakdown of Florida's population by five age brackets and gender alongside the same breakdown for the entire country:

(in 000's)	M 0-18	M 19-44	M 45-64	M 65-84	M 85+	F 0-18	F 19-44	F 45-64	F 65-84	F 85+	TOTAL
United States	37,910 (12.3%)	56,824 (18.4%)	39,882 (12.9%)	15,662 (5.1%)	1,810 (0.6%)	36,209 (11.7%)	56,133 (18.1%)	41,891 (13.0%)	19,273 (6.2%)	3,733 (1.2%)	309,326 (100.0%)
Florida	2,046 (10.9%)	1,253 (6.7%)	2,454 (13.0%)	1,300 (6.9%)	160 (0.8%)	1,954 (10.4%)	3,215 (17.3%)	2,644 (14.0%)	1,541 (8.2%)	279 (1.5%)	18,846 (100.0%)

As you can see, Florida's population is more heavily skewed towards older individuals. The chart below helps to illustrate the material differences in health care spending between different age groups:



To account for these differences and allow for a more appropriate comparison of costs and premiums, we developed state-specific age/gender factors using the nationwide NHE data. The national factors and four states with the largest factors, including Florida, are shown in the following tables:

Age/Gender Factors from NHE Data

	M 0-18	M 19-44	M 45-64	M 65-84	M 85+	F 0-18	F 19-44	F 45-64	F 65-84	F 85+
National Factors	.52	.46	1.15	2.24	4.46	.50	.79	1.21	2.23	5.11

States with Largest Age/Gender Adjustments

State	Age/Gender Factor	2009 HCC	Adjusted 2009 HCC
Alaska	0.887	\$9,128	\$10,289
Florida	1.092	\$7,156	\$5,551
Maine	1.090	\$8,521	\$7,818
Utah	0.873	\$5,031	\$5,760

After normalizing the health care costs for each state, we ran another regression using these adjusted health care costs and 2014 exchange data. This regression produced $r = 0.664$ and $R^2 = 44.1\%$. Again, the strength of the relationship between costs and premiums was enhanced from the prior model.

2015

During the course of our analysis, we were able to gain access to 2015 exchange data for 31 states in the federally facilitated marketplace. Using only the 2015 premiums and the normalized 2009 HCC, the least-squares regression for these 31 states produced r and R^2 values of 0.783 and 61.3%, respectively.

We then went back to the 2014 premiums for these same 31 states to see if there had been an improvement in the alignment of costs and premiums in 2015. The 2014 analysis for these same 31 states produced r and R^2 values of 0.658 and 43.4%, respectively. The enhanced strength of the relationship and improved predictive power of the least-squares regression led us to believe that many unknowns of the 2014 marketplace led to some pricing disruption in that year which is beginning to be resolved as more becomes known about the marketplace rules and participants.

CONCLUSIONS

We originally hypothesized that health care costs would be strong predictors of insurance premiums. After conducting our analysis, we were able to identify some key observations regarding the relationship between these two variables:

- ♦ **The alignment between costs and premiums is improving.** As final rules surrounding the ACA become clearer and more is known about the enrollees in the exchanges, we anticipate the improved alignment we recognized in 2015 will continue going forward.

 - In our original 2014 analysis, we identified Minnesota as an outlying state with high health care costs and unusually low premiums. We had wondered whether this signified something unique was happening in Minnesota that led to this result or if the state would eventually experience an uptick in exchange premiums to better reflect its overall cost position. Relying on estimates from the Department of Health and Human Services, premiums for the benchmark silver plan in Minnesota went up approximately 2% nationwide in 2015. In Minnesota, the increase (according to a Dec. 2014 report by The Commonwealth Fund) was 17%. This lends support to the idea that 2014 uncertainty led to some distortion in the cost-premium relationship.
- ♦ **Health Care Costs are not everything.** While we were able to increase our r and R^2 values considerably throughout the process, it is clear that premiums in the individual exchanges vary by state for reasons other than general cost and utilization differences reflected in the NHE data. This analysis could be enhanced to consider other drivers of premium differentials such as the level of competition in a state/market, the number of plans available in a state/market, etc.