



# Quantile regression analysis of the effects of health maintenance organization enrollment on medical expenditures

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Presented at the International Conference on Health Policy Statistics, October 6, 2011, Cleveland, OH

## 1. Background

- Since the early 1970's, health maintenance organizations (HMOs) have been used, with mixed results, to try to constrain ever-increasing health expenditures.
- The effects of HMO enrollment may be different for patients with higher or lower expenditures, but this has not been previously investigated.
- Quantile regression (QR), which models the relationship between an exposure and conditional quantiles of an outcome given a set of covariates, may be useful.
- The Medical Expenditure Panel Survey (MEPS) is one of the few publicly available sources of detailed population-based data on expenditures by HMO enrollees.

## 2. Methods

- We used 2008 data from MEPS (all ages, n=31,262).
- The main outcome variable was total expenditures, and the main exposure was HMO enrollment, regardless of payor.
- Covariates included sociodemographic and health status characteristics, comorbidities, insurance type, region/urbanicity, and having a usual source of care.
- All analyses were conducted in SAS 9.2 using weights, cluster, and strata variables to account for the complex survey design.
- Multivariable QR models of total expenditure at four different quantiles were fitted and compared to a multivariable OLS model. Reduced models removed 4 nonsignificant variables. A sensitivity analysis removed 4,271 uninsured respondents from the non-HMO cohort.

## 3. Results

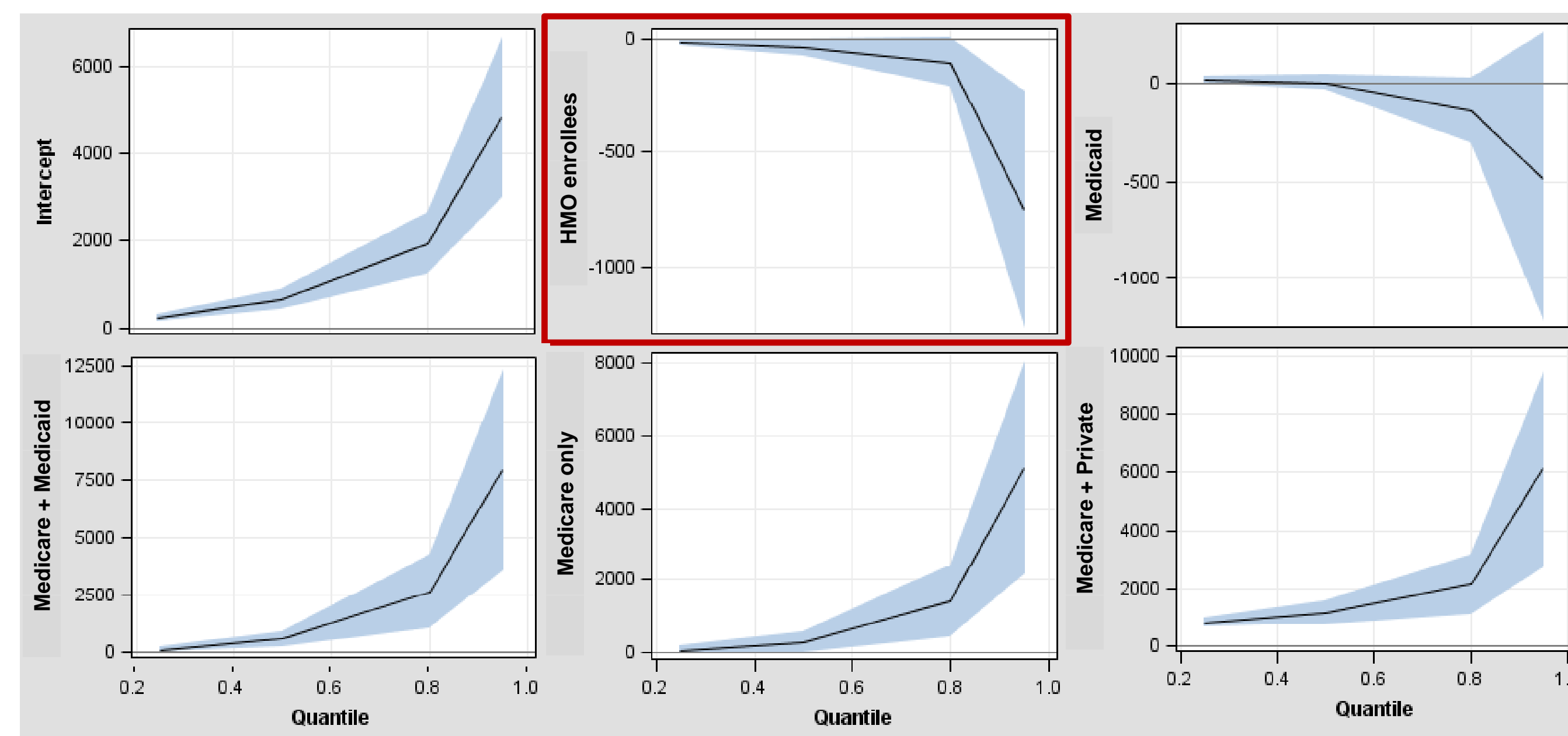
- In 2008, 23.4% of all respondents were in an HMO (27.0% of all insured).
- Mean total expenditures ( $\pm$ SE) were \$3,665  $\pm$  \$96 in the non-HMO cohort vs. \$4,127  $\pm$  \$141 in the HMO cohort.
- The OLS model found that HMO enrollment reduced total expenditures by \$543 ( $P=.001$ ).
- The QR models found a monotonically increasing trend of greater savings with greater cost expenditures. At the 25th percentile, savings were \$16; at the 50th, \$40; at the 80th, \$102; and at the 95th, \$752 (**Table 1**).
- Graphical output illustrates that the effect of HMOs is greater at higher quantiles of expenditure (**Figure 1, red box**).

**Table 1. Results of quantile regression models**

Model	Parameter	25th Percentile	50th Percentile	80th Percentile	95th Percentile
Full	Est Effect of HMO	-\$15	-\$37	-\$87	-\$587
	Lower 95% CL	-\$28	-\$75	-\$196	-\$1,229
	Upper 95% CL	-\$1	1.488	\$22	\$55
	<i>P</i>	.030	.060	.118	.073
Reduced	Est Effect of HMO	-\$16	-\$40	-\$102	-\$752
	Lower 95% CL	-\$30	-\$74	-\$213	-\$1,357
	Upper 95% CL	-\$2	-\$6	\$9	-\$147
	<i>P</i>	.022	.022	.071	.015

- Results from the sensitivity analysis (removing uninsured from the sample) were similar.

**Figure 1. Selected graphical output from quantile regression model – estimated parameter by quantile with 95% CLs**



## 4. Conclusions

- QR modeling in a nationally representative sample suggests that HMOs are cost-saving at all quantiles of total expenditure, with larger cost containment effects patients with higher costs.
- QR methods revealed that most of the cost savings identified by OLS for the average patient were driven by patients with higher costs.
- QR is a robust tool that provides a complete picture of the covariate effect when a set of percentiles is modeled, allowing analysts to delve deeper into findings from other regression methods.