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RESEARCH ARTICLE

Using Quantile Regression to Examine Health Care Expenditures during the Great Recession

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Objective. To examine the association between the Great Recession of 2007–2009 and health care expenditures along the health care spending distribution, with a focus on racial/ethnic disparities.

Data Sources/Study Setting. Secondary data analyses of the Medical Expenditure Panel Survey (2005–2006 and 2008–2009).

Study Design. Quantile multivariate regressions are employed to measure the different associations between the economic recession of 2007–2009 and health care spending. Race/ethnicity and interaction terms between race/ethnicity and a recession indicator are controlled to examine whether minorities encountered disproportionately lower health spending during the economic recession.

Principal Findings. The Great Recession was significantly associated with reductions in health care expenditures at the 10th–50th percentiles of the distribution, but not at the 75th–90th percentiles. Racial and ethnic disparities were more substantial at the lower end of the health expenditure distribution; however, on average the reduction in expenditures was similar for all race/ethnic groups. The Great Recession was also positively associated with spending on emergency department visits.

Conclusion. This study shows that the relationship between the Great Recession and health care spending varied along the health expenditure distribution. More variability was observed in the lower end of the health spending distribution compared to the higher end.

Key Words. Health care expenditures, quantile regression, economic recession, racial and ethnic disparities

The longest of any recession since World War II officially began in December 2007 and ended in June 2009 (National Bureau of Economic Research 2010; Cawley, Moriya, and Simon 2011). Higher unemployment rates are one of the most widely recognized indicators of a recession. The national unemployment rate was 5.0 percent in December 2007 and 9.5 percent in June 2009 at the end of the recession; this increase was greater than any recession in recent

decades (U.S. Bureau of Labor Statistics 2012). The economic recession had different impacts across different racial and ethnic groups. Inflation-adjusted median wealth fell from $18,359 in 2005 to $6,325 in 2009 (66 percent) among Latino households, and from $12,124 in 2005 to $5,677 in 2009 (53 percent) among African American households, compared with a decline from $134,992 to $113,149 (16 percent) among white households (Kochhar, Fry, and Taylor 2011).

The Great Recession was significantly associated with a lower incidence of health care utilization (Lusardi, Schneider, and Tufano 2010; Dorn et al. 2012; Mortensen and Chen 2013). It also slowed health care spending to historical low growth, driven by reductions in spending on inpatient visits, physician visits, and drugs (Martin et al. 2012). Spending growth decelerated across payers, including private insurers, Medicare, Medicaid, and out-of-pocket payments (Martin et al. 2012). The recession could have had heterogeneous effects across the distribution of health care expenditures, types of expenditures, and health insurance coverage. In addition, heterogeneous racial/ethnic disparities across the health care expenditure distribution existed before the recession (Cook and Manning 2009) and may have been exacerbated during the recession. This is the first study to investigate the differential relationship between the Great Recession and health care spending across the distributions of health care expenditures, with a focus on racial/ethnic disparities.

Examining health care expenditures improves upon outcome variables such as utilization counts because it captures the variation in intensity of care (Cook and Manning 2009). Health care expenditures are highly concentrated and not evenly distributed, with only 5 percent of the U.S. population accounting for approximately half of health care expenditures, and half the population spending little or nothing on health care (Stanton 2006; Cohen and Yu 2010). Health spending may be indicative of consumers' different health needs (Cook and Manning 2009). Lower expenditures reflect consumer demand for

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relatively elastic primary and preventive health care services, and they may be driven by differential access to and preferences for preventive services (Cook and Manning 2009). The higher expenditures may reflect consumer demand for more inelastic, expensive, and intensive health care services, such as chronic illness and high-technology care, especially among those individuals with severe health issues.

In this study, we investigate whether the Great Recession is associated with variation in annual health care expenditures at the lower (e.g., $100) and higher tails (e.g., $10,000) of the health care expenditure distribution. Populations likely reduced their health care expenditures as a consequence of income and health insurance loss during the recession (Newhouse and Phelps 1976; Liu and Chollet 2006; Santerre and Neun 2009). Higher health care expenditure may indicate higher intensity care for conditions where treatment is perhaps less elective and more urgent, such as cancer treatment (Santerre and Neun 2009). Demand for primary health care services (e.g., prescription drug use, physician visits) might be more income sensitive, compared to the demand for the expensive health care services. Thus, we hypothesize that the economic recession may relate to a relatively substantial reduction in health spending at the lower end of the distribution. In addition to total health care spending, we also examine spending on physician visits, prescription drugs, and inpatient and emergency department (ED) visits during the recession. These specific types of care are analyzed to capture potential trade-offs in care-seeking behavior during the recession. Spending on care at sites such as EDs and hospitals may have increased as a result of delaying care or skipping drug doses.

Health care spending of racial and ethnic minorities varies significantly from that of whites at lower levels of the spending distribution (Cook and Manning 2009). The Great Recession disproportionately affected household wealth, unemployment rates, and health insurance coverage of minorities. Consequently, we also examine racial/ethnic disparities in health expenditure adjustments along the expenditure distribution between minority populations and whites. We hypothesize that while the magnitude of health expenditure variation will differ across racial/ethnic groups, more variability will be observed in the lower end of the health expenditure distribution compared to the higher end of the distribution, reflecting need and intensity of care.

This is the first study to investigate the association between the Great Recession and the heterogeneous impact along the health spending distribution of different populations. It is critical to examine the recession association across the distribution of health care expenditures to characterize the role of

need and preferences in individuals' adjustment of health expenditure after recession periods. The Great Recession of 2007–2009 had several impacts and may have reduced health care access and altered health expenditure patterns, but it may have also increased the demand for high-priced care at the expense of reduced primary care utilization. Employing a quantile regression approach, we are able to examine the possible disproportionate changes across the health care expenditure distribution during the Great Recession.

METHOD

Data

We use nationally representative data from the 2005–2006 and 2008–2009 Medical Expenditure Panel Survey (MEPS) (Cohen, Cohen, and Banthin 2009). The MEPS Household Component is first collected at the household level, and information from each household member is recorded subsequently. The response rate averages from 60 to 70 percent. Our analysis includes the noninstitutionalized, civilian population ages 18–64 years.

Our outcome variables are annual health care expenditures per person: total health care spending and spending on specific types of health care services, including physician visits, prescription drug, outpatient visits, inpatient visits, ED visits, and other services (such as dental care, vision care, etc.). These expenditures are aggregate direct payments including patients' out-of-pocket payments and those from third parties (i.e., private health insurance, Medicaid, Medicare, and other sources) during the survey year. Health care expenditures are self-reported and validated by respondents' providers. All health expenditures are adjusted to constant dollars using the 2010 Consumer Price Index medical component.

Variables

Our key explanatory variable is a dichotomous indicator equal to 1 if the survey year was 2008–2009, and 0 if the survey year was 2005–2006. The Great Recession officially started in December 2007. Thus, we compare health care expenditures in 2008–2009 (during the recession) to 2005–2006 (before the recession). Interaction terms of this recession indicator with race and ethnicity (whites [reference group], Latinos, African Americans, Asian Americans, and other races) are included as well to capture the dynamics of the recession's disparate effects across race/ethnicity. We create three categories of health

insurance coverage (public insurance, private insurance, uninsured) to compare health expenditure variability across focus populations.

In our multivariate analyses, we adopt the following variables, which have been used extensively in the previous literature (Mohanty et al. 2005; Ku 2009). These variables include respondents' age, gender, race/ethnicity (white, Latino, African American, Asian American, other race), marital status (married), education (no high school degree, high school degree, college degree, and advanced degree), interview language (English vs. other), citizenship/immigration status (U.S.-born, U.S.-naturalized, non-U.S. citizen), self-reported health status (excellent, very good, good, fair, poor), self-reported mental health status (excellent, very good, good, fair, poor), the SF short-form 12 (SF12): a physical component summary (PCS) and a mental component summary (MCS) scores (Ware, Kosinski, and Keller 1996; Salyers et al. 2000; Cheak-Zamora, Wyrwich, and McBride 2009), a vector of indicators for chronic disease (diabetes, hyperlipidemia, hypertension, heart diseases, osteoarthritis, asthma, depressive disorder, and anxiety disorder) (Cook and Manning 2009), family income (below 100 percent Federal Poverty Line [FPL], 100–200 percent FPL, and above 200 percent FPL), health insurance coverage (uninsured, public health insurance, private health insurance), having usual source of care, living in an urban area, and U.S. Census Region (North East, Midwest, South, West).

Analysis

Quantile multivariate regressions are employed to estimate the different associations between the recession and health care expenditures along the health care expenditure distribution (Koenker and Hallock 2001; Koenker 2005). In quantile regressions, coefficients at the lower percentiles of the expenditures distribution (e.g., the 10th, 25th, and 50th percentiles) reflect the association between the Great Recession and expenditures on low-intensity health care, or the demand for and access to primary health care services (e.g., prescription drug use, physician visits). The recession coefficient at the higher percentiles of expenditures (e.g., the 75th, 90th percentiles) indicates the association between the Great Recession and high-intensity care (such as the highly intensive cares or expensive high-technology care).

In our data, we observe zero-mass expenditures in total health spending and spending on specific types of services. Zero expenditure may indicate no utilization, and it may also reflect populations' unwillingness to spend on health care. Likewise, it may be related to good health status. Thus, we use a

two-part model to first analyze the probability of encountering any health care expenditure for all the populations using multivariate logistic regressions. Among populations with positive spending, we employ a quantile regression approach to estimate the association of the economic recession across the distributions of health care expenditures. We use the natural log of health care expenditures to adjust for the skewed distribution of the data. The two-step approach has been widely adopted in the literature (Goldberger 1964; Cragg 1971).

Quantile regression is an ordinary regression, that is, we have similar results if we use natural logs (cost+$1) to avoid the zero-mass expenditures, compared to the results from the two-part models (Parzen 2004; Cook and Manning 2009). In this study, we are particularly interested in health care expenditures. Zero expenditure may indicate unwillingness to pay or perception of good health status, in addition to zero utilization. Thus, we use the two-part model with quantile regression estimation to parse out between those with no expenditure and those with positive spending. Nevertheless, in the sensitivity analysis, we estimate both models and our results are similar using natural logs (cost+$1).

We first summarize health care expenditures before and during the economic recession. The probability of having any health care expenditures and expenditures at different percentiles (10th, 25th, 50th, 75th, 90th) are summarized from the lower levels of health care spending to the higher level of health care expenditures. We use multivariate logistic regression to estimate the association between the Great Recession and the probability of having any health care expenditure, distinguishing by race/ethnicity. We then implement the quantile regressions to estimate the different associations between the Great Recession and different levels of health care expenditures, controlling for the full set of covariates. Subsequently, we use the same models to estimate the association between the recession and spending on different types of health care services, including prescription drugs, physician visits, ED visits, inpatient stays, outpatient visits, and other services. To get the robust standard errors, we cluster the sample by household and use the bootstrap technique with 100 repetitions (Koenker and Bassett 1982; Gould 1992; Rogers 1992). STATA 12 (StataCorp LP, College Station, TX, USA) is used for all the analyses.

Although we try to capture the recession association with health care spending, it is likely that unobserved market and geographic variation due to the uneven distribution of unemployment factors might exist and confounded our findings. We thus conduct several sensitivity analyses. The first sensitivity test is a difference-in-difference analysis controlling for the interaction term of

family income and the recession indicator. The rationale is that people with lower family income might be affected more severely under the recession and would be more likely to reduce health care spending especially at the lower end of the health care distribution, compared to people with high family income. In addition to the difference-in-difference test, we also perform the stratified tests by family income levels, that is, examining the associations of recession indicators with different levels of family income, respectively. Secondly, we test the robustness of the quantile regression results to the estimates from the two-part multivariate regressions. Finally, the 2007–2009 economic recession might impact spending in the following years. We include the 2010 data in the analysis to test the sensitivity of our results.

RESULTS

Unadjusted Health Expenditure

Table 1 summarizes the details of the health care expenditure distribution. The 10th percentile of total health care expenditures across all services was $166 during 2008–2009, approximately 20 percent lower than the 10th percentile of expenditures, $204, during 2005–2006. At the higher end of the distribution, the 90th percentile of total health care expenditures was $11,424 during 2008–2009, only a 3 percent reduction compared to the 90th percentile value of $11,706 during 2005–2006. Similarly, the 10th, 25th, and 50th percentiles corresponding to prescription drug expenditures were $17, $58, and $287 in 2008–2009, an approximately 50 percent reduction from the respective 2005–2006 figures: $32, $113, and $447, respectively. Table 1 also shows substantial variation in health care expenditures along the distributions. For example, the average health care spending, if any, was $4,905 in 2008–2009, with variation from $166 to $11,424 from 10th–90th percentiles.

Sample Characteristics

Sample characteristics varied significantly at different levels of health care expenditures. Approximately 39 percent among those who had low health care expenditures were whites, followed by Latinos, 34 percent, and African Americans, 19 percent. These ratios of race and ethnicity changed substantially in the high health care expenditure category. Approximately 61 percent of the populations with high expenditure were whites, followed by 16 percent Latinos, and 17 percent African Americans. Variation in health care expenditures may also

Table 1: Summary Statistics of Health Care Expenditures before and during Economic Recession

		Health Care Cost If Any					
	Any Cost		Percentiles				
Before Recession (2005–2006)	Probability	Mean	10%	25%	50%	75%	90%
$ Total costs	0.91	5,101.52	204.31	573.28	1,745.08	4,909.5	11,706.23
$ Physician visits	0.78	1,463.39	78.1	175.47	472.55	1,325.21	3,216.14
$ Prescription drugs	0.75	1,428.84	32.45	112.97	446.53	1,545.31	3,701.68
$ Outpatient visits	0.18	2,551.64	82.03	210.28	808.76	2,642.34	6,279.64
$ Inpatient visits	0.09	14,139.31	1,987.85	4,198.04	7,455.99	14,443.76	30,114.61
$ ED visits	0.16	1,220.99	120.18	257.65	599.64	1,301.53	2,888.43
$ Other services	0.64	714.13	0.001	69.32	234.36	598.52	1,574.77
Recession (2008–2009)							
$ Total costs	0.90	4,905.29	166.44	487.08	1,522.53	4,611.26	11,424.22
$ Physician visits	0.77	1,421.04	79.63	173.91	474.67	1,342.80	3,296.85
$ Prescription drugs	0.74	1,323.31	16.55	57.61	287.01	1,188.57	3,453.69
$ Outpatient visits	0.16	2,612.26	90.85	219.79	763.55	2,523.32	6,510.82
$ Inpatient visits	0.09	14,267.67	1,718.84	3,926.35	7,317.39	14,682.82	34,219.93
$ ED visits	0.15	1,463.71	110.65	265.67	686.67	1,606.03	1,606.03
$ Other services	0.63	746.22	0.001	42.68	212	548.1	1,461.25

reflect different health outcomes. People with poorer health and more chronic diseases, such as diabetes, hypertension, hyperlipidemia, and mental disorders, were the majority of those who had high health care expenditures. In addition to the race/ethnicity and health outcomes, female citizens, the elders, U.S.-born citizens, and insured people were more likely to appear at the higher level of health care expenditure distribution as well (Table 2).

Any Spending

The recession was significantly associated with lower likelihoods of having any total expenditure, prescription drug expenditure, outpatient expenditure,

Table 2: Summary Statistics of Sample Characteristics by Percentiles of Total Health Care Expenditures (unit: 100%, unless noted otherwise)

	Having No Cost	*10th Percentile*	*25th Percentile*	*50th Percentile*	*75th Percentile*	*90th Percentile*
Age (year)	36.02	36.49	38.00	40.63	44.57	46.05
Female	0.38	0.48	0.53	0.59	0.62	0.66
Married	0.41	0.46	0.52	0.56	0.58	0.55
Race/ethnicity						
White	0.36	0.39	0.46	0.56	0.62	0.61
Latino	0.39	0.34	0.28	0.21	0.17	0.16
African American	0.18	0.19	0.18	0.16	0.15	0.17
Asian	0.04	0.06	0.06	0.05	0.04	0.03
Other race	0.03	0.02	0.02	0.02	0.02	0.03
U.S. citizenship/nativity						
U.S.-born	0.67	0.70	0.73	0.78	0.83	0.85
U.S.-naturalized	0.08	0.10	0.10	0.10	0.09	0.08
Non-U.S. citizens	0.25	0.20	0.17	0.12	0.08	0.07
Self-reported health						
Excellent	0.26	0.26	0.26	0.25	0.19	0.13
Very good	0.32	0.34	0.36	0.35	0.34	0.25
Good	0.32	0.30	0.29	0.29	0.31	0.32
Fair	0.09	0.09	0.08	0.09	0.12	0.20
Poor	0.01	0.01	0.01	0.02	0.04	0.11
Self-reported mental health						
Excellent	0.35	0.38	0.39	0.37	0.34	0.26
Very good	0.31	0.31	0.32	0.32	0.31	0.26
Good	0.29	0.26	0.25	0.25	0.27	0.30
Fair	0.04	0.05	0.04	0.05	0.07	0.13

Continued

Table 2. *Continued*

	Having No Cost	*10th Percentile*	*25th Percentile*	*50th Percentile*	*75th Percentile*	*90th Percentile*
Poor	0.01	0.01	0.01	0.01	0.01	0.04
SF12-PCS (1–100)	52.92	52.58	52.62	51.73	49.30	43.31
SF12-MCS (1–100)	50.72	50.74	50.83	50.38	49.56	47.03
Diabetes	0.01	0.03	0.03	0.06	0.11	0.19
Hyperlipidemia	0.02	0.04	0.06	0.12	0.22	0.29
Heart disease	0.00	0.00	0.00	0.01	0.02	0.06
Hypertension	0.04	0.09	0.12	0.19	0.29	0.37
Osteoarthritis	0.00	0.00	0.00	0.01	0.03	0.05
Asthma	0.02	0.04	0.04	0.05	0.08	0.11
Depressive disorder	0.05	0.05	0.05	0.08	0.14	0.22
Anxiety disorder	0.02	0.03	0.03	0.06	0.09	0.15
Education						
No high school degree	0.38	0.33	0.28	0.21	0.20	0.23
High school degree	0.46	0.46	0.44	0.44	0.43	0.44
College degree	0.08	0.11	0.14	0.18	0.18	0.16
Advanced degree	0.08	0.10	0.14	0.17	0.19	0.17
Family income						
Low family income (≤100% Federal Poverty line [FPL])	0.23	0.21	0.17	0.13	0.13	0.18
Median family income (100–200% FPL)	0.30	0.27	0.23	0.18	0.16	0.18
High family income (>200% FPL)	0.46	0.52	0.60	0.69	0.71	0.63
Health insurance						
Uninsured	0.50	0.33	0.23	0.15	0.11	0.07
Private health insurance	0.41	0.52	0.64	0.74	0.76	0.69
Only public health insurance	0.10	0.15	0.13	0.11	0.14	0.25
Having usual source of care	0.39	0.63	0.71	0.80	0.87	0.89

Continued

Table 2. *Continued*

	Having No Cost	*10th Percentile*	*25th Percentile*	*50th Percentile*	*75th Percentile*	*90th Percentile*
Unemployed	0.17	0.17	0.17	0.17	0.22	0.35
Interviewed in English	0.75	0.79	0.84	0.89	0.92	0.93
Urban	0.85	0.84	0.85	0.84	0.84	0.82
U.S. Census Region						
Northeast	0.10	0.12	0.14	0.15	0.16	0.17
Midwest	0.17	0.19	0.19	0.22	0.23	0.23
South	0.41	0.40	0.39	0.37	0.36	0.37
West	0.32	0.29	0.28	0.26	0.24	0.23

Source: Medical Expenditure Panel Survey (2005–2006 and 2008–2009); the total sample size was 53,872.

inpatient expenditure, and expenditures on other services. However, the likelihood of having any ED expenditure increased significantly during the recession (OR = 1.23, $p < .001$). The association between the recession indicator and the probability of having any spending on physician visit was nonstatistically significant (Table 3).

Total Health Care Spending

The recession was significantly associated with lower health care expenditures at the lower end of the distribution (coef = −0.21, $p < .001$; coef = −0.19, $p < .001$; coef = −0.06, $p < .01$; at the 10th–50th percentile of the distribution), but not at the higher end of the health expenditure distribution. Racial and ethnic differences in health care expenditures were more substantial at the lower end. These differences, however, disappeared in upper percentiles. The corresponding interaction terms of recession and race/ethnicity for these percentiles were nonstatistically significant (Table 4).

Prescription Drug Spending

The recession was significantly associated with lower prescription drug expenditures across the distribution. The association was more robust at the lower percentiles (coef = −0.68, $p < .001$, 10th percentile; coef = −0.61, $p < .001$, 25th percentile; coef = −0.41, $p < .001$, 50th percentile; coef = −0.23, $p < .001$, 75th percentile; coef = −0.06, $p < .05$, 90th percentile). Racial/ethnic minorities reported significantly lower drug expenditures across the distribution of prescription drugs, and these disparities remained at the upper percentiles. The significant negative coefficient on the interaction term of Latinos and recession indicates that, during the recession, Latinos reduced expenditures on prescription drugs more compared to whites.

Spending on Physician Visits

The Great Recession was associated with higher physician expenditures at the 75th–90th percentiles. Compared to whites, Latinos, African Americans, and Asians had significantly lower physician spending, especially at the lower end of the distribution. The interaction terms of recession and Latinos shows that Latinos increased physician spending more at the 10th percentile (coef = 0.11, $p < .05$), but they significantly reduced physician spending at the 75th and 90th percentiles (coef = −0.12, $p < .05$; coef = −0.17, $p < .001$), compared to whites.

Table 3: Multivariate Logistic Regression Results across Race/Ethnic Groups: The Association of Recession and the Likelihoods of Having Any Health Care Expenditure and Type of Expenditure on Different Health Care Services

	$Total Spending OR	*$ Physician Visits OR*	*$ Prescription Drugs OR*	*$ Outpatient Visits OR*	*$ Inpatient Visits OR*	*$ ED Visits OR*	*$ Other Services OR*
Before recession (2005–2006)	Reference	Reference	Reference	Reference	Reference	Reference	Reference
Recession (2008–2009)	0.88*	1.02	0.92**	0.90***	0.90*	1.23***	0.91***
Whites	Reference	Reference	Reference	Reference	Reference	Reference	Reference
Latinos	0.72***	0.84**	0.74***	0.85*	1.09	1.23***	0.75***
African Americans	0.65***	0.69***	0.71***	0.83***	1.13	1.34***	0.70***
Asians	0.52***	0.70***	0.56***	0.81	0.92	0.85	0.72***
Other races	0.64**	0.78*	0.78*	0.81	1.06	0.95	0.78*
Latinos × Recession	1.04	0.96	1.04	1.05	1.01	0.97	1.06
African Americans × Recession	1.08	0.87*	1.04	1.04	1.00	0.97	1.09
Asians × Recession	1.38	1.17	0.89	0.84	0.77	1.02	1.10
Other races × Recession	1.00	0.82	1.00	1.05	0.70	0.67*	1.02

Note. All the other covariates were controlled. The total sample size for each of the regression $n = 53{,}872$. The adjusted R-square ranged from 0.07 (ED) to 0.24 (total).
***$p < .001$; **$p < .01$; *$p < .05$.

Table 4: Quantile Regression Results: The Association of Recession and Health Care Expenditures

	10th Percentile Coef	*25th Percentile Coef*	*50th Percentile Coef*	*75th Percentile Coef*	*90th Percentile Coef*
Total health care expenditures					
Before recession (2005–2006)	Reference	Reference	Reference	Reference	Reference
Recession (2008–2009)	−0.21***	−0.19***	−0.06**	−0.03	0.01
Whites	Reference	Reference	Reference	Reference	Reference
Latinos	−0.29***	−0.24***	−0.14***	−0.11***	−0.10*
African Americans	−0.36***	−0.33***	−0.22***	−0.14***	0.00
Asians	−0.42***	−0.43***	−0.28***	−0.22***	−0.22
Other races	−0.02	−0.08	−0.05	−0.10	−0.12
Latinos × Recession	0.04	0.04	−0.05	−0.08	−0.03
African Americans × Recession	0.00	0.01	−0.04	−0.03	−0.08
Asians × Recession	0.01	0.02	−0.08	−0.10	−0.08
Other Races × Recession	−0.35**	−0.16	−0.12	−0.03	0.11
Prescription drug expenditures					
Before recession (2005–2006)	Reference	Reference	Reference	Reference	Reference
Recession (2008–2009)	−0.68***	−0.61***	−0.41***	−0.23***	−0.06*
Whites	Reference	Reference	Reference	Reference	Reference
Latinos	−0.24***	−0.20***	−0.15***	−0.12***	−0.11*
African Americans	−0.36***	−0.35***	−0.35***	−0.26***	−0.24***
Asians	−0.42**	−0.40***	−0.25***	−0.34***	−0.36***
Other races	−0.16	−0.18*	−0.18*	−0.16	−0.08
Latinos × Recession	−0.08	−0.19***	−0.24***	−0.19***	−0.24***
African Americans × Recession	−0.08	−0.06	−0.11*	−0.11*	−0.04
Asians × Recession	−0.09	−0.01	−0.16	−0.09	−0.07
Other Races × Recession	−0.16	−0.12	−0.04	0.01	−0.04
Physician visits expenditures					
Before recession (2005–2006)	Reference	Reference	Reference	Reference	Reference

Continued

Table 4. *Continued*

	10th Percentile Coef	*25th Percentile Coef*	*50th Percentile Coef*	*75th Percentile Coef*	*90th Percentile Coef*
Recession (2008–2009)	−0.04	0.01	0.04	0.07**	0.06*
Whites	Reference	Reference	Reference	Reference	Reference
Latinos	−0.12**	−0.14***	−0.12***	0.00	0.03
African Americans	−0.26***	−0.28***	−0.25***	−0.25***	−0.12*
Asians	−0.20*	−0.27***	−0.33***	−0.35***	−0.22*
Other races	−0.06	0.06	0.01	−0.01	−0.01
Latinos × Recession	0.11*	0.05	−0.01	−0.12**	−0.17**
African Americans × Recession	0.09	0.08	0.03	0.04	−0.04
Asians × Recession	0.03	−0.05	−0.02	0.03	−0.09
Other races × Recession	−0.05	−0.17	−0.17	−0.08	−0.06
Outpatient expenditures					
Before recession (2005–2006)	Reference	Reference	Reference	Reference	Reference
Recession (2008–2009)	0.01	0.03	0.02	0.02	0.05
Whites	Reference	Reference	Reference	Reference	Reference
Latinos	0.00	−0.07	−0.28*	−0.11	−0.12
African Americans	−0.17	−0.16	−0.14	−0.01	0.14
Asians	−0.30	−0.22	−0.50*	−0.44	−0.52*
Other races	−0.11	0.12	0.42*	0.01	0.00
Latinos × Recession	0.15	0.20	0.36*	0.18	0.24
African Americans × Recession	0.21	0.12	−0.08	−0.08	−0.30*
Asians × Recession	0.34	0.24	0.19	0.25	0.34
Other races × Recession	0.13	−0.45	−0.76*	−0.23	−0.34
Inpatient expenditures					
Before recession (2005–2006)	Reference	Reference	Reference	Reference	Reference
Recession (2008–2009)	−0.28**	−0.08	−0.02	0.05	0.11
Whites	Reference	Reference	Reference	Reference	Reference

Continued

Table 4. *Continued*

	10th Percentile Coef	*25th Percentile Coef*	*50th Percentile Coef*	*75th Percentile Coef*	*90th Percentile Coef*
Latinos	−0.34*	−0.15	−0.14*	−0.07	−0.09
African Americans	−0.36*	−0.17*	−0.03	0.06	0.23*
Asians	−0.09	−0.06	−0.12	0.23	−0.12
Other races	−0.90	0.10	−0.12	−0.01	−0.17
Latinos × Recession	0.19	0.07	0.11	0.06	0.14
African Americans × Recession	0.13	0.09	−0.02	−0.06	−0.17
Asians × Recession	0.24	0.11	−0.06	−0.23	−0.07
Other races × Recession	0.66	−0.33	0.18	0.10	0.42
ED visits expenditures					
Before recession (2005–2006)	Reference	Reference	Reference	Reference	Reference
Recession (2008–2009)	−0.05	0.12*	0.23***	0.28***	0.28***
Whites	Reference	Reference	Reference	Reference	Reference
Latinos	−0.11	0.07	0.03	−0.06	0.01
African Americans	0.02	0.00	0.06	0.00	0.00
Asians	−0.06	−0.02	−0.04	0.16	0.19
Other races	0.00	−0.07	0.14	0.12	0.04
Latinos × Recession	−0.03	−0.08	−0.15	−0.03	−0.22
African Americans × Recession	−0.15	−0.23*	−0.21**	−0.20	−0.18
Asians × Recession	−0.36	−0.43	−0.15	−0.55*	−0.86***
Other races × Recession	−0.18	−0.24	−0.32	−0.25	−0.35
Other services expenditures					
Before recession (2005–2006)	Reference	Reference	Reference	Reference	Reference
Recession (2008–2009)	−0.59***	−0.19***	−0.07***	−0.05	−0.02
Whites	Reference	Reference	Reference	Reference	Reference
Latinos	−0.62***	−0.25	−0.14*	−0.23***	−0.33***
African Americans	−0.78***	−0.81***	−0.18***	−0.14***	−0.08

Continued

Table 4. *Continued*

	10th Percentile Coef	*25th Percentile Coef*	*50th Percentile Coef*	*75th Percentile Coef*	*90th Percentile Coef*
Asians	−0.59	−0.33	−0.12	−0.03	0.00
Other races	−0.58	−0.43	−0.06	0.10	0.11
Latinos × Recession	0.02	−0.62*	−0.12	0.02	0.05
African Americans × Recession	0.28	−0.23	−0.09	−0.08	−0.06
Asians × Recession	0.42	0.25	0.11	−0.13	−0.25*
Other races × Recession	0.24	0.26	−0.08	−0.22	−0.13

Note. All the other covariates were controlled for all percentiles.
***$p < .001$; **$p < .01$; *$p < .05$.

Spending on ED Visits

The recession was positively associated with ED expenditures at higher percentiles (coef = 0.12–0.28, $p < .001$; 25th–90th percentiles). Racial/ethnic disparities in ED expenditures were nonstatistically significant. Asians had lower ED expenditures during the recession at the 75th and 90th percentile.

Spending on Inpatient and Outpatient Visits

The associations between recession and outpatient and inpatient spending were generally not significant across the health spending distribution. Racial and ethnic disparities in these expenditures were also not significant.

Spending on Other Services

The recession was associated with lower expenditures on other services from the 10th to the 50th percentiles (coef = −0.59, $p < .001$; coef = −0.19, $p < .001$; coef = −0.07, $p < .001$). Differences between whites versus Latinos and African Americans were significant at these percentiles as well.

Sensitivity Analysis

We first examine the total health care expenditures by family income, using the difference-in-difference analysis. Compared to populations with high family income, individuals with low-median family income had significantly lower health care expenditures at 10th–75th percentiles. The interaction terms of family income and recession indicator show that people with low-median family income spent significantly less on health care during the economic recession, especially at the lower end of the spending distribution (coef = −0.12, $p < .05$ at 10th percentile; coef = −0.09, $p < .05$ at 25th percentile). We also separate the analysis by different levels of family income, respectively. The pattern of the associations of the economic recession and total cost is similar for high, median, and low family income. The negative relationship between recession and health care expenditures was more substantial for population with low and median family income (coef = −0.25, $p < .05$ at 10th percentile; coef = −0.15, $p < .05$ at 50th for low family income; coef = −0.34, $p < .001$ at 10th percentile; coef = −0.24, $p < .05$ at 25th for median family income; coef = −0.18, $p < .001$ at 10th percentile; coef = −0.05, $p < .05$ at 50th for high family income) (Table 5).

We estimate the two-part multivariate regressions to get the average recession effect on health care expenditures. The linear regression shows that the total health care expenditures were significantly lower during the recession (coef = −0.06, $p < .001$) compared to the prerecession period on average. The results are consistent with the findings of the quantile regressions (Table S1). We also conduct a sensitivity analysis by combining 2010 survey year as the postrecession period. The results are almost identical (the results are available upon request).

DISCUSSION

This study shows that the associations between the Great Recession and health care expenditure varied along the health expenditure distribution. We hypothesized that more variability would be observed in the lower end of the health spending distribution compared to the higher end. Our results confirm the hypothesis that the Great Recession was associated with significant drops in health care expenditures, particularly in the probabilities of having any health care expenditure, and the lower end of its distribution, given any expenditure. This finding implies that health care access and spending in primary care might have been more adversely impacted during the recession compared to higher intensity care that may be more inelastic due to health need. This finding is consistent with previous findings on reductions in health care utilization (Mortensen and Chen 2013) and spending during the recession (Karaca-Mandic, Yoo, and Sommers 2013).

Our results did not show a significant relationship between the recession and health expenditures at higher distributions of health care spending, which indicated that the health needs of populations requiring a large amount of health care resources were not impacted. Individuals with higher health spending may have been less willing to substitute health spending as this type of spending is more likely to be inelastic due to perceived health need (Newhouse and Phelps 1976; Santerre and Neun 2009). For instance, individuals with relatively low health spending, such as on primary care, may have been more willing to go without annual doctor checkups or a flu shot, whereas patients being treated for cancer may not have been as willing to reduce their health spending due to the immediacy of perceived need.

We find lower prescription drug expenditures along with higher ED spending during the recession. The slow growth in prescription drugs during

Table 5: Quantile Regression of Total Health Care Expenditure by Family Income[a]

	10th Percentile Coef	*25th Percentile Coef*	*50th Percentile Coef*	*75th Percentile Coef*	*90th Percentile Coef*
Before recession (2005–2006)	Reference	Reference	Reference	Reference	Reference
Recession (2008–2009)	−0.18***	−0.17***	−0.05**	−0.03	0.00
Family income					
High family income (>200% FPL)	Reference	Reference	Reference	Reference	Reference
Low-median family income (≤200% FPL)	−0.16***	−0.17***	−0.16***	−0.15***	−0.06
Interaction term					
Low-median family income × Recession	−0.12*	−0.09*	−0.04	0.03	0.02
Stratified quantile regressions by family income[b]					
Low family income (≤100% FPL)					
Recession (2008–2009)	−0.26*	−0.27***	−0.15*	−0.04	0.02
Median family income (>100% FPL & ≤200% FPL)					
Recession (2008–2009)	−0.34***	−0.24***	−0.09	−0.02	0.08
High family income (>200% FPL)					
Recession (2008–2009)	−0.18***	−0.17***	−0.05**	−0.02	0.01

Note. ***$p < .001$; **$p < .01$; *$p < .05$.
[a]All the other covariates were controlled for all percentiles.
[b]Separate quantile regressions by low, median, and high family incomes; only the coefficients of recession indicators were reported, with before recession (2005–2006) as the reference group; all the other covariates were controlled for all the regressions.
FPL, Federal Poverty Line.

the recession was driven by slower growth in the volume of drugs consumed, and increases in the use of generic drugs, among other factors (Cunningham 2012; Martin et al. 2012). Given the cross-sectional study design, we are not able to tell whether the higher spending on ED visits resulted from lower prescription drug use. However, literature shows that prescription drugs can significantly improve quality of life while reducing expenditures on inpatient stays and emergency department visits (Lichtenberg 2001). Hence, our results are suggestive that some substitution across types of health spending occurred particularly among individuals in the higher end of the health expenditure distribution.

Racial and ethnic disparities increased during the recession, with a very pronounced drop in prescription drug spending among Latinos. Latinos may have been more willing to reduce utilization of brand name drugs or switch to generic drugs due to the disproportionate impact of the Great Recession in this specific population group. In addition, it is worth noting that these racial and ethnic disparities in drug expenditures existed along the spending distribution. The results indicate not only that racial and ethnic minorities had poorer access to prescription drugs (reflected by the disparities in the lower level of prescription drug expenditures) before the Great Recession but also that access worsened during the recession, particularly in the case of brand name drugs (reflected by the disparities in the higher level of the prescription drug cost). These results may indicate the heterogeneous role of culture and personal preferences in the willingness to substitute prescription to generic drugs across racial/ethnic groups.

This study showed that the economic recession was associated with higher physician spending, especially at the higher end of the distribution of physician expenditure, which may be indicative of resilience of physician payments to income shocks. Because supply of physicians is limited and substitutes are not available, physician expenditures remain relatively constant and individuals have less flexibility to adjust their respective health expenditure as in other categories of health expenditure such as prescription drugs or hospitalization. Results also showed that this association varied by health insurance status. The increase in physician spending was more significant among individuals with private insurance (results not shown but available upon request). This finding supports previous research that showed significant drops in physician visits (Mortensen and Chen 2013). Increased physician spending, however, may be indicative of less income elasticity of health spending for services provided by highly priced physician services. Individuals may be more

willing to sacrifice visits to primary care providers than to specialists due to perceived need.

Expenditures on other services, such as dental care and vision care, were significantly reduced during the recession. Racial and ethnic disparities in utilization of dental care and vision care have been well identified (Gilbert et al. 2002; Heisler et al. 2003; Dolan, Atchison, and Huynh 2005). This study shows that these disparities remained significant during the recession. Future research should further explore the consequences of health outcomes resulted from the reduced utilization of these services, particularly among the racial and ethnic minority populations.

Consistent with previous research (Holahan 2010; Mortensen and Chen 2013), this study shows that the reduction in health care expenditure was generally similar across race/ethnicity during the economic recession. We only find a disproportionate drop in prescription drug spending for the racial and ethnic minorities during the recession, particularly in the case of Latinos. These results may indicate that the racial and ethnic disparities of health care expenditures were similar during the great recession, compared to the prerecession period.

This study has several important limitations. First, given the MEPS survey design, we are only able to conduct a cross-sectional analysis. Thus, it is not possible to establish a causal relationship between the economic recession and health care expenditures. It is likely that the trends of health care spending during 2005–2006 and 2008–2009 were affected by other unobserved factors, such as geographic variation in unemployment across the United States and the implementation of different state and local policies to mitigate the impact of the recession on health expenditures. Future research is needed to estimate the impact of economic recession on health care expenditures by geographic areas. It will also be interesting to estimate the long-term health effect due to the reduced health care expenditures. Second, health care expenditures were self-reported and had recall bias, although doctors and pharmacists validated expenditure reports. Third, different health care expenditures may reflect the severity of health illness. We control for four self-reported health status, SF12 PCS and MCS scores, and indicators for the common chronic diseases. However, it is still likely that the severity of different conditions was not fully captured.

The findings from this study have important policy implications. Provisions in the Affordable Care Act may affect health care spending, particularly for the low-income families that had greater reductions in spending during the recession. Policies such as those mandating Essential Health

Benefits, which prioritize low-cost services with a high benefit to society such as vaccination or chronic disease detection and management, may prove beneficial at avoiding decreased utilization of these services during economic recessions. The expansion of eligibility in Medicaid programs in some states in 2014 for individuals with income up to 138 percent of the Federal Poverty Level allows many individuals who were not previously eligible to enroll in Medicaid. Subsidies for purchasing insurance through the state-based marketplaces will result in more low-income individuals with insurance coverage. Individuals with preexisting conditions will not be excluded from purchasing affordable insurance coverage, and cost sharing for U.S. Preventive Services Task Force recommended A and B services will be eliminated by the Affordable Care Act. All of these provisions, as well as others in the Act, should lessen the burden of health care spending for low-income families and may help to narrow racial/ethnic disparities in health care spending.

Conclusion

The traditional linear multivariate regression analysis of health spending primarily demonstrates associations with average expenditure measures and therefore may have limited use due to the skewed nature of the health care expenditure distribution. The quantile regression method used in this study, by contrast, exposes the disproportionate concentration of health care expenditures in small shares of the population. This study demonstrates that the Great Recession was associated with a more pronounced reduction in lower health expenditure percentiles that can be indicative of reductions in cost-effective primary care services. By contrast, this study shows just a minor reduction in upper health expenditure percentiles indicative of stable spending on high-intensity care such as expensive organ transplants, magnetic resonance imaging, cancer chemotherapy, and chronic disease care likely due to perceived need to save lives and reduce suffering. Our results show that racial and ethnic disparities persisted during the recession. In addition, findings of decreased prescription drug cost and higher ED and physician spending during the Great Recession may relate to the delays in seeking primary care and resilience of physicians' pay to economic crises, respectively. Future research should examine the trade-off among different types of health care services and the geographic heterogeneity of spending and health spending, distinguishing between elastic and inelastic health expenditures.

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SUPPORTING INFORMATION

Additional supporting information may be found in the online version of this article:

Appendix SA1: Author Matrix.
Table S1: Results of the Second Stage of the Two-Part OLS Regression.