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Essays on Healthcare Access, Use, and Cost Containment

by

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ABSTRACT

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This dissertation is composed of two essays that examine the role of public and private health insurance on healthcare access, use, and cost containment.

In Chapter 1, Dugan, Virani, and Ho (2012) examine the impact of Medicare eligibility on healthcare utilization and access. Although Medicare eligibility has been shown to generally increase health care utilization, few studies have examined these relationships among the chronically ill. We use a regression-discontinuity framework to compare physician utilization and financial access to care among people before and after the Medicare eligibility threshold at age 65. Specifically, we focus on coronary heart disease and stroke (CHDS) patients. We find that Medicare eligibility improves health care access and physician utilization for many adults with CHDS, but it may not promote appropriate levels of physician use among blacks with CHDS.

My second chapter examines the extent to which the managed care backlash affected managed care's ability to contain hospital costs among short-term, non-federal hospitals between 1998 and 2008. My analysis focuses on health maintenance organizations (HMOs), the most aggressive managed care model. Unlike previous studies that use cross-sectional or fixed effects estimators to address the endogeneity of HMO penetration with respect to hospital costs, this study uses a fixed effects instrumental variable approach. The results suggest two conclusions. First, I find the impact of increased HMO penetration on costs declined over the study period, suggesting regulation adversely impacted managed care's ability to contain hospital costs. Second, when costs are decomposed into unit costs by hospital service, I find the impact of increased HMO penetration on inpatient costs reversed over the study period, but HMOs were still effective at containing outpatient costs.

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Introduction

In the United States, rising health expenditures represent a significant challenge to our long-term national prosperity. According to the Centers for Medicare and Medicaid Services, National Health Expenditures (NHE) as a fraction of Gross Domestic Product (GDP) has grown from 7% in 1970 to almost 18% of the economy in 2008. Even if the Centers for Medicare and Medicaid Services program expenditures (e.g., Medicare, Medicaid, and Children's Health Insurance Program) are excluded, NHE as a fraction of GDP still grow from 6% to almost 11% during the same time period. Along with a rapidly aging population and mandates for improving health quality, runaway health expenditures are the most significant contributor to the nation's deficit. Thus, the challenge of any deficit reduction plan is to decrease NHE without impacting the quality of healthcare services delivered. This dissertation is composed of two essays that examine the role of public and private health insurance on healthcare access, use, and cost containment.

In Chapter 1, Dugan, Virani, and Ho (2012) examine changes in healthcare access and utilization associated with Medicare eligibility among adults with coronary heart disease and stroke (CHDS). Descriptive statistics and regression discontinuity analysis were used to examine healthcare access and utilization at the Medicare eligibility threshold at age 65 for 176,611 National Health Interview Survey respondents aged 55-74 surveyed between 1997 and 2010. We found that adults with CHDS reported a higher propensity to make one or more office-based physician visits at age 65 than adults with no other major chronic disease (MCD). Adults with CHDS also reported greater reductions in cost as a barrier to care at age 65 than adults with no MCD. The subgroup analysis revealed that Hispanics and highly educated adults with CHDS reported the highest propensity to make two or more office visits at age 65. However, blacks with CHDS reported a decline in their propensity to make two or more office visits at age 65. Medicare eligibility improves healthcare access and utilization for many adults with CHDS, but it may not promote appropriate levels of physician use among some groups.

Consumer dissatisfaction with the quality and limitations of managed health care led to rapid disenrollment from managed care plans and demands for regulation between 1998 and 2003. Managed care companies, particularly health maintenance organizations (HMOs), now face a regulatory environment that restricts them from using their most aggressive strategies for managing costs. Chapter 2 examines the extent to which this backlash affected managed care's ability to contain costs among short-term, non-federal hospitals. Fixed effects and instrumental variables estimation were used to address the potential endogeneity of HMO penetration with respect to hospital costs.

The results suggest two conclusions. First, I find the impact of increased HMO penetration on costs declined over the study period, suggesting regulation adversely impacted managed care's ability to contain hospital costs. Second, when costs are decomposed into unit costs by hospital service, I find the impact of increased HMO penetration on inpatient costs reversed over the study period. HMOs were still effective at containing outpatient costs.

Chapter 1

Medicare Eligibility and Physician Utilization Among Adults with Coronary Heart Disease and Stroke

1.1 Introduction

Coronary heart disease and stroke are the two largest components of cardiovascular disease (CVD), the leading cause of disability and death in the United States. Of the 831,804 CVD-related deaths in 2007, 406,351 (49%) involved coronary heart disease and 227,215 (27%) involved stroke (Roger et al., 2011). Following an acute event, the management of either coronary heart disease or stroke requires continual monitoring and oftentimes treatment involving costly procedures and medications.

For these patients, health insurance plays a crucial role in managing their condition and improving health outcomes. Approximately 16% of adults aged 45-64 in the United States are uninsured, as compared with 2% of adults aged 65 years and older (DeNavas-Walt et al., 2011). This inequality in coverage is largely attributed to Medicare eligibility rules which give adults access to generous coverage at age 65.

Previous studies examining the impact of Medicare on health outcomes have shown that Medicare eligibility contributes to reductions in cost as a financial barrier to care and increased utilization of health care services (Decker and Rapaport, 2002; Card, Dobkin, and Maestas, 2008; Bhattacharya and Lakdawalla, 2005; Lichtenberg, 2002;

McWilliams et al., 2003). Further, these studies showed that populations covered by Medicare benefit substantially from Medicare coverage, as measured by health outcomes and utilization. However, few studies report health outcomes and utilization for patients with known morbidities, and we know of no such studies for CVD (Decker and Rapaport, 2002). Using a nationally representative data set, this study examines the impact of Medicare eligibility on healthcare access and utilization among adults with CVD which includes coronary heart disease and stroke (CHDS).[1]

We found that adults with CHDS reported a higher propensity to make one or more office-based physician visits at age 65 than adults with no major chronic disease (MCD). Adults with CHDS also reported greater reductions in cost as a barrier to care at age 65 than adults without MCD. The subgroup analysis revealed that Hispanics and highly educated adults with CHDS reported the highest propensity to make two or more office visits at age 65. However, blacks with CHDS reported a decline in their propensity to make two or more office visits at age 65. Overall, Medicare eligibility improves healthcare access and utilization for many adults with CHDS, but it may not promote appropriate levels of physician use among some groups.

The remainder of this paper is organized as follows. Section 2 presents the econometric framework. The data are summarized in Section 3 and the results are presented in Section 4. The final sections conclude and discuss policy implications.

[1]The results in this chapter have been published. Citation: Dugan, Virani, and Ho (2012).

1.2 Econometric Framework

Establishing the casual relationship between health insurance and the use of health care services is complicated by the endogeneity of health insurance. Since individuals are not randomly assigned health insurance, factors, such as health status, may lead to self-selection bias. One way to resolve this self-selection problem is to use the exogenous variation generated by Medicare eligibility rules.

Our identification strategy uses a regression discontinuity (RD) design to examine the impact of turning age 65 (Card et al., 2008). That is, most people become eligible for Medicare coverage when they reach age 65, creating a discrete change in coverage at that age (U.S. Department of Health and Human Services, 2010; Social Security Administration, 2008). Regression Discontinuity analysis uses discrete changes like this to identify the intended effect of an endogenous mechanism (Imbens and Lemieux, 2008; Lee and Lemieux, 2011).

1.2.1 Regression Discontinuity Design

Let $Y_{i,t}$ be a measure of healthcare utilization or access to care for individual i in survey year t:

$$Y_{i,t} = \beta Age_{i,t} + \gamma D_i + \delta X_{i,t} + \mu_{i,t} \tag{1.1}$$

where Age denotes the age of individual i, X is a set of individual covariates, and μ is an unobserved error component. D is a dummy variable which indicates Medicare eligibility: one if the respondent was aged 65 and older at the time of the survey or zero otherwise. When age is included as an additional explanatory variable, the estimated coefficient on the Medicare eligibility indicator becomes a RD term which captures the effect of Medicare coverage.

Regression discontinuity regressions were estimated by ordinary least squares for each health status group, then by health status and race/ethnicity or educational attainment. Along with age, we control for several individual characteristics, which include, quadratic age, sex, race/ethnicity, educational attainment, geographic region, and survey year. Some controls for educational attainment or race/ethnicity may be excluded depending on the subgroup being analyzed. We used sampling weights to adjust for oversampling. The standard errors were clustered by age groups to account for interclass correlation arising from the degenerative effects of aging.

1.3 Data

The National Health Interview Survey (NHIS), administered by the U.S. Census Bureau and maintained by the National Center for Health Statistics, is a population-based, cross-sectional survey of the civilian, noninstitutionalized U.S. population. Each year approximately 40,000 households (roughly 100,000 individuals) are questioned about their medical history and sociodemographic characteristics which impact health. We used data from the 1997-2010 core NHIS survey (sample-adult and person-level files) to create a data set of adults aged 55-74.

1.3.1 Physician Utilization

The primary outcome variables were physician visits, access to care, and supplemental insurance coverage. In the NHIS survey, a categorical question was used to assess how frequently each respondent used physician services. Respondents were asked how many times in the past year they saw a doctor or other health care professional about their health at a doctors office, a clinic, or some other place. One or more office visits was chosen to proxy for basic access and use of non-emergency physician services. Two or more office visits was chosen to proxy for a schedule of care required to routinely monitor CVD risk factors (e.g., weight, blood pressure, cholesterol, and blood glucose levels) to avoid future acute events.

1.3.2 Access to Care

Respondents were identified as having financial barriers to access care in the past year if medical care was delayed because of worry about the cost or if medical care was not received because of affordability problems. Respondents with two or more forms of health insurance were identified as having supplemental insurance coverage.

1.3.3 Health Status Groups

Respondents were assigned to one of three health status groups: diagnosed with CHDS, diagnosed with a major chronic disease (MCD) other than CHDS, or diagnosed with no MCD. A CHDS diagnosis was assigned if the respondent was told by a doctor or other health professional that that they had coronary heart disease, a heart attack, angina pectoris, or a stroke. A MCD other than CHDS diagnosis was determined if the respondent was told by a doctor or other health professional that they had chronic pulmonary disease, diabetes, or cancer (Centers for Disease Control and Prevention, 2004). In this study, chronic pulmonary disease was defined as having chronic bronchitis, emphysema, or chronic asthma. Individuals who were not informed they had a MCD were identified as having no MCD. Adults diagnosed with a major chronic disease other than CHDS were excluded from the analysis.

Our decision to aggregate coronary heart disease and stroke into one reporting group was based on the fact that coronary heart disease and stroke share the same pathophysiology. Coronary heart disease and stroke are two distinct diseases, but they have overlapping atherosclerotic disease mechanisms and similar risk prediction algorithms (D'Agostino et al., 2008; Kim and Johnston, 2011). While the treatment for both diseases may vary substantially in their acute phase, follow-up care focuses on monitoring related risk factors like hypertension, diabetes, and elevated cholesterol levels. We therefore assumed that both diseases have the same patterns of physician monitoring; however, it may be the case that the influence of each risk factor is different for the two diseases in such a way that monitoring varies (Pendlebury et al., 2004).

Respondents who self-identified as Hispanic or Latino were identified as Hispanic regardless of race. Whites and blacks with no Hispanic or Latino ancestry were identified as white non-Hispanic (white) and black non-Hispanic (black), respectively. All other respondents were identified as "Other." In this study, we focused our subgroup analysis on the three largest race/ethnic categories: Hispanic, white and black.

1.3.4 Measuring Socioeconomic Status

Income was reported as a categorical variable in the NHIS survey. A cross-sectional analysis would not be limited by this categorical measurement; however, because of inflation, these categories change over time. Thus, the income cutoffs cannot be matched from year to year. In the labor economics literature, educational attainment has been used as a substitute for income (Card, 1995). Education can be a better measure of socioeconomic status because it measures socioeconomic status before old age entitlement programs, i.e., Medicare and Social Security, impact income (Bhattacharya and Lakdawalla, 2005). Respondents with less than 12 years of education or a general education degree were identified as high school dropouts. Respondents with a high school diploma were categorized as high school graduates and respondents with any post-secondary education (for any duration) were categorized as having some college experience.

Summary statistics for physician use and access to care were tabulated for each health status group by race/ethnicity, or educational attainment. We used respondents aged 60-64 and 65-69 to generate baseline levels of pre/post-Medicare access to care and utilization, respectively. For each subgroup, adults with CHDS and adults without MCD were compared using two-sample t-tests. Medicare coverage rates by age were graphed for adults with CHDS and adults without MCD. This figure allowed us to summarize Medicare coverage rates before and after age 65 and clearly identified the resulting discontinuities.

1.4 Results

1.4.1 Main Results

Summary statistics are reported in Table 1.1. The pooled NHIS data set contained 200,248 respondents aged 55-74 surveyed between 1997 and 2010. The mean age of this sample was 63. Females comprised slightly over half of the sample at 54%, and whites represented 69% of the sample. Just over 45% of respondents reported having at least some college experience. In this study, we limit our analysis to adults with CHDS and adults without MCD. This left us with 176,611 respondents: 15,945 with CHDS and 160,666 without MCD. Summary statistics for each subgroup were also reported. Sample counts by health status group, race, and education are reported in Appendix Table A.1.

We assumed that both coronary heart disease and stroke have the same patterns of physician monitoring. In support of this assumption, we compared the propensity to use physician services for coronary heart disease and stroke at the Medicare eligibility threshold. We found no evidence to suggest that patterns of use varied between the health status groups (Appendix Table A.2). Figure 1.1 presents Medicare coverage rates by age for each health status group. The graph shows that adults with CHDS were more likely to have Medicare coverage than adults without MCD at every age. Before age 65, these differences could be well over 20%. The important feature of this graph is that it demonstrates the Medicare eligibility age rule generates a discrete jump in coverage at age 65. Full Medicare coverage uptake was not observed at age 65, because some individuals choose not to enroll due to access to other forms of comprehensive insurance (Card, Dobkin, and Maestas, 2008). Additional figures describing Medicare coverage by subgroup are reported (Figure A.1).

Baseline utilization and RD estimates are presented in Table 1.2. Overall, adults with CHDS had a higher propensity to make one or more office-based visits prior to Medicare eligibility (94.9%) relative to adults without MCD (84.0%). Adults with CHDS also had a higher propensity to make two or more office-based visits (88.2%) than adults without MCD (66.4%). Blacks with CHDS had the highest propensity to make two or more office visits (90.4%), and Hispanics without MCD had the lowest propensity to make two or more office visits (55.7%).

In general, the RD estimates show an increased propensity to make one or more and two or more office-based visits. At age 65, adults with CHDS increased their propensity to make one or more office visits by 1.7% (p=0.03) relative to their younger counterparts. This increase is in addition to the higher likelihood of adults with CHDS making one or more office visits prior to age 65. Among adults without MCD, only high school dropouts reported statistically significant increase in their propensity to make two or more office visits at age 65 (2.4%, p=0.01). Hispanics with CHDS and adults with some college experience with CHDS also reported an increased propensity to make two or more office visits at age 65 (9.5%, p=0.04 and 2.4%, p<0.01). Blacks with CHDS decreased their propensity to make two or more office visits at age 65 (-2.1%, p=0.05). Baseline access to care and supplemental insurance coverage and RD estimates are shown in Table 1.3. Overall, 8.6% of adults without MCD reported barriers to care, while adults with CHDS report much higher rates at 15.5%. Blacks, low-educated adults, and Hispanics with CHDS reported the highest barriers to access care at 21.9%, 18.9%, and 17.8%, respectively. Seven-point-two percent of adults without MCD reported having supplemental coverage while adults with CHDS report much higher rates at 20.2%. Blacks and high school dropouts reported the highest rates of supplemental coverage at 21.3% and 23.7%, respectively. Hispanics reported the lowest rate of supplemental coverage at 12.0%.

At age 65, adults with CHDS reported a greater reduction in barriers to care at age 65 for adults with CHDS (-3.6%, p<0.01), relative to adults without MCD (-2.0%, p=0.01). Although Hispanics reported the largest increase in propensity to make visits, blacks reported the greatest decline in barriers to care at age 65 (7.3%, p=0.03). For Hispanics and blacks with CHDS, these declines in barriers to care were due to relatively high financial difficulties in obtaining care prior to age 65. The RD estimates show a substantial increase in supplemental insurance coverage across all groups at age 65.

1.4.2 Robustness

We estimated three alternative specifications (Appendix Table A.3 and Appendix Table A.4). First, we test to robustness of the finding that blacks and Hispanics with CHDS decreased or increased their propensity to make two or more physician visits at age 65, by examining interactions between race/ethnicity and education. We verify our results are robust to interactions between race and educational attainment.

Second, the robustness of the results to the included controls was investigated by limiting the right-hand-side variables to the RD term, quadratic age, and survey years. By excluding most individual characteristics from the model, we verified that no single variable drives the results. Next, the robustness of the results to the age bandwidth selected was investigated by restricting our window of analysis to adults aged 60-69. Doing so allowed us to verify the consistency of the estimates over different age windows. In this specification, we were able to verify the sign and magnitude of the results for blacks with CHDS, but we were unable to find statistical significance. This may be due to the fact that under a shorter age window, subgroup samples were too small to make meaningful inferences.

1.5 Conclusion

While previous studies have examined the impact of Medicare eligibility on the use of health care services, relatively few studies have investigated this association among the chronically ill (Decker and Rapaport, 2002; Card, Dobkin, and Maestas, 2008). This study is the first to estimate the impact of Medicare eligibility at age 65 on healthcare access and utilization for the two largest components of cardiovascular disease, coronary heart disease and stroke. The results of this study contributes to our understanding of the appropriate use of physician services among adults with CHDS and the extent to which Medicare eligibility impacts disparities in health care access and utilization.

Our main results show that prior to age 65, adults with CHDS were more likely to quality for Medicare than adults without MCD. These results are consistent with early Medicare eligibility guidelines which allow persons diagnosed with chronic heart failure, myocardial infarctions, ischemic heart disease, arrhythmias, congenital heart defects, angina pectoris, and valve defects to apply for supplemental security income (SSI) or social security disability (SSD) benefits (U.S. Department of Health and Human Services, 2010). Being diagnosed with one of the named conditions does not guarantee acceptance into the SSI or SSD programs; however, individuals with advanced conditions are more likely to gain entry, which is consistent with the data presented.

A discrete jump in insurance coverage, as a result of Medicare eligibility rules, allowed us to use RD methods to estimate the impact of Medicare coverage on health care access and use. We found that Medicare eligibility increased the propensity for adults to make one or more office-based visits, decreased barriers to care, and increased the propensity for adults to have supplemental insurance coverage relative to adults just under age 65. Minorities with CHDS reported the greatest declines in barriers to care, although these declines were due to higher baseline levels of financial difficulties.

Conversely, some socioeconomically disadvantaged adults with CHDS appeared to seek frequent care from physicians at a lower rate than comparable patients who had not reached age 65. For blacks with CHDS, reaching Medicare eligibility led to statistically significant declines in their propensity to make two or more office visits. On the other hand, Hispanics with CHDS report the largest rise in their propensity to make two or more office visits. These results differed significantly from the results for white and highly educated adults. There are a number of possible explanations for both findings.

First, economic models of the demand for health insurance tell us that households which anticipate credit constraints in the future are expected to become more risk averse (Schnewider, 2004). These credit constraints are often the result of income and health status shocks that increase demand for insurance. For those who are poor or suffering from a chronic disease, costly care can drive up insurance premiums to unaffordable levels, leaving many individuals underinsured.

Compared to the general population, blacks are disproportionally poor and affected by cardiovascular disease. Further, for blacks with CHDS, underinsurance is evidenced by the sharp increase in supplemental insurance coverage disparities between subgroups. Their lack of supplemental insurance coverage make them responsible for both the Medicare Part B deductible, 20% of the cost for each physician medical visit, and approved medication (Card, Dobkin, and Maestas, 2008; Centers for Disease Control and Prevention, 2004). Thus, the various forms of cost-sharing in Medicare may still lead socioeconomically disadvantaged persons to curtail utilization on the margin.

Another explanation may be attributed to whites and highly educated patients' ability to better utilize Medicare. Disparities in health care utilization between racial and educational groups have been studied extensively (Decker and Rapaport, 2002; Card, Dobkin, and Maestas, 2008; Gornick et al., 1996; Gornick, 2003; Dunlop et al., 2002; Sudore et al., 2006; Rooks et al., 2002), with several studies examining utilization within fully insured populations (Virani et al., 2011; Peterson et al., 2008; Groeneveld, Heidenreich, and Garber, 2003; Pilote et al., 2003; Groeneveld et al., 2007; Rooks et al., 2007). Racial and socioeconomic differences in the use of CVD hospital procedures within insured populations are still seen (Virani et al., 2011; Peterson et al., 2008; Jha et al., 2003). Disparities in outcomes appear to be minimized in the Veteran's Affairs system of equal health care access (Pilote et al., 2003; Groeneveld et al., 2007). Less is known about disparities in preventative care in similar environments (Virani et al., 2011; Peterson et al., 2008). Understanding these disparities is crucial to minimizing future acute events (Virani et al., 2011; Peterson et al., 2008; Jha et al., 2003).

Higher treatment rates for Hispanic Medicare patients relative to blacks have been identified in inpatient care (Cromwell et al., 2005; Eggers and Greenburg, 1998). In particular, Cromwell and his coauthors found that white patients admitted for ischemic heart disease had the highest rates of invasive procedures, blacks had the lowest, and Hispanics were in between (Cromwell et al., 2005). Furthermore, the jump in utilization at age 65 for Hispanics may be attributable to the large disparity in health insurance coverage between non-elderly Hispanics and non-Hispanics (Rutledge and McLaughlin, 2008). Additional analysis generally confirms these trends (Appendix Table A.5 and Appendix Table A.6).

Our study contributes to the literature by demonstrating the role that Medicare plays in improving health care access for adults with CHDS and the potential weakness in the program for blacks. Insurance status and financial concerns about accessing care have been found to play a crucial role in the timing of care for heart attack patients (Smolderen et al., 2010). Declining use of routine services at age 65 highlights a need for policies which ensure that adults with CHDS receive routine monitoring of CVD risk factors. Expansions of Medicaid under the new federal health care reform law may create one vital source of supplemental insurance coverage. For the most disadvantaged Medicare beneficiaries who also qualify for Medicaid, or dual eligibles, researchers have found that dual eligible blacks used more office-based physician services than whites (Moon and Shin, 2006). Apart from insurance, some racial groups may still not be able to get good quality care if they lack access to transportation to make it to their appointment, access to a land line or cell phone to schedule an appointment, or a support system to help them make it to their appointments. Future research should focus on examining how supplemental insurance and these additional constraints impact health care access and use.

There are several limitations to the interpretation of these results. First, respondents to the NHIS survey are sampled every year, such that our inferences regarding the effects of Medicare eligibility are drawn from annual cohorts of persons at each age, rather than from repeated observations of the same individuals as they age. Second, our estimates for physician use focus on office visits, which may lead to underestimation of utilization if patients substitute emergency room visits for office visits. We examine the use of emergency care and find similar patterns of utilization (Appendix Table A.7). However, since health care utilization measures are recorded as categorical variables, we are unable to create global measures of utilization. Additionally, our models assume the only major event that occurs at age 65 is Medicare eligibility, but other events, e.g., retirement, may also occur. We include employment status as an additional control and find our results are robust to its inclusion (Appendix Table A.8). These retirements may bias our results, but it is more likely that substantial discontinuities exist for every year after age 62 (the earliest possible retirement age for Social Security). Last, we cannot rule out the possibility that the decline in two or more office visits per year for blacks with CHDS reflects better management of disease symptoms with medications or access to better physicians due to Medicare coverage. However, nine of the twelve years of data in our sample are years prior to the implementation of Medicare Part D in 2006, so this is less likely an issue.

Given that reaching Medicare eligibility is associated with reductions in the frequent use of physician services for blacks with CHDS, future studies should investigate the underlying causes of this decline. The decline in multiple annual visits could be the result of improved care under Medicare, but it might also reflect shortcomings in the Medicare program for socioeconomically disadvantaged patients with CVD.

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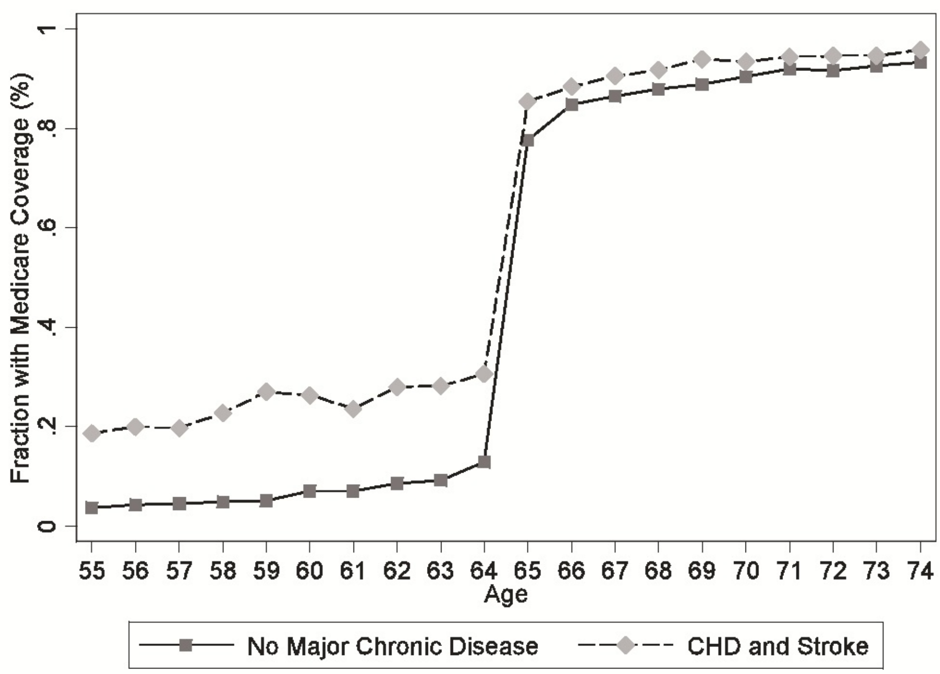


Figure 1.1 : Medicare coverage rates in respondents by age and health status

Table 1.1 : Summary Statistics

Variable	*All National Health Interview Survey Respondents*		*Respondents with no major chronic disease*		*Respondents with coronary heart disease and stroke*	
Age	63.1		62.8		65.2	
	(0.0)	N=200,248	(0.0)	N=160,666	(0.0)	N=15,945
Female	53.5		53.2		46.0	
	(0.0)	N=107,051	(0.0)	N=85,519	(0.0)	N=7,341
White	69.4		67.0		71.2	
	(0.0)	N=138,946	(0.0)	N=110,838	(0.0)	N=11,358
Black	12.4		11.9		14.9	
	(0.0)	N=24,880	(0.0)	N=19,154	(0.0)	N=2,375
Hispanic	13.3		13.6		10.3	
	(0.0)	N=26,076	(0.0)	N=21,808	(0.0)	N=1,641
High school dropout	25.1		23.7		35.0	
	(0.0)	N=57,372	(0.0)	N=36,429	(0.0)	N=5,532
High school graduate	29.8		30.3		27.0	
	(0.0)	N=57,372	(0.0)	N=46,499	(0.0)	N=4,259
At least some college	45.2		46.0		38.0	
	(0.0)	N=87,161	(0.0)	N=70,636	(0.0)	N=6,007

Standard deviations in parentheses. All values specified as percentages unless otherwise noted. Mean differences for the two health status groups were generally significant at the 1% confidence level.

Table 1.2 : RD estimates† at age 65 for office-based physician visits with p-values and sample size

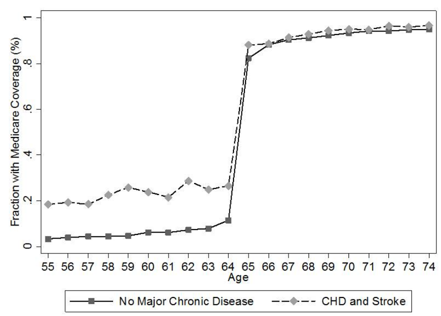
	Dependent Variable: Office Based visits (1+)				*Dependent Variable: Office Based visits (2+)*			
	No Major Chronic Disease		*CHD and Stroke*		*No Major Chronic Disease*		*CHD and Stroke*	
	Mean Before Age 65 ‡	*RD At 65*	*Mean Before Age 65*	*RD At 65*	*Mean Before Age 65*	*RD At 65*	*Mean Before Age 65*	*RD At 65*
Overall Sample	84.0	0.5	94.9	1.7*	66.4	0.9	88.2	1.4
	(0.3)	[0.07]	(0.4)	[0.03]	(0.4)	[0.31]	(0.6)	[0.09]
		N=55,635		N=15,576		N=55,635		N=15,576
By Ethnicity:								
Whites	85.6	0.2	95.3	1.3*	67.7	1.0	88.6	1.1
	(0.4)	[0.08]	(0.5)	[0.02]	(0.5)	[0.42]	(0.7)	[0.16]
		N=39,543		N=11,125		N=39,543		N=11,125
Blacks	81.2	1.9	95.7	0.7	66.1	1.6	90.4	-2.1*
	(1.1)	[0.10]	(0.9)	[0.29]	(1.3)	[0.37]	(1.7)	[0.05]
		N=7,133		N=2,307		N=7,133		N=2,307
Hispanics	74.2	3.0	88.3	8.2	55.7	2.2	79.4	9.5*
	(1.4)	[0.26]	(2.3)	[0.06]	(1.6)	[0.35]	(2.9)	[0.04]
		N=6,503		N=1,592		N=6,503		N=1,592
By Education:								
High school dropout	76.0	3.4*	93.7	1.9	60.5	2.4**	86.9	1.8
	(0.9)	[0.05]	(0.9)	[0.25]	(1.0)	[0.01]	(1.2)	[0.34]
		N=12,371		N=5,453		N=12,371		N=5,453
High school graduate	83.4	-0.7	94.8	2.6**	64.1	1.4	88.9	0.1
	(0.6)	[0.23]	(0.8)	[0.01]	(0.9)	[0.15]	(1.1)	[0.94]
		N=16,322		N=4,196		N=16,322		N=4,196
At least some college	87.4	-0.1	96.0	1.0**	69.8	-0.1	88.9	2.4**
	(0.4)	[0.89]	(0.6)	[0.01]	(0.6)	[0.95]	(1.0)	[p<0.01]
		N=26,942		N=5,927		N=26,942		N=5,927

† All estimates were weighted to adjust for oversampling and the standard errors were clustered by age groups.
‡ Mean for respondents age 60-64.
* Statistically significant at the 5% confidence level; ** Statistically significant at the 1% confidence level.

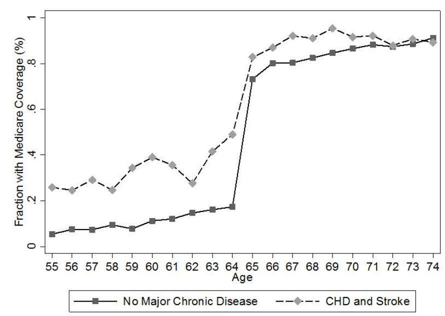
Table 1.3 : RD estimates† at age 65 for access to care and supplemental insurance with p-values and sample size

	Dependent Variable: Financial Barriers to Care				*Dependent Variable: Supplemental Insurance*			
	No Major Chronic Disease		*CHD and Stroke*		*No Major Chronic Disease*		*CHD and Stroke*	
	Mean Before Age 65 ‡	*RD At 65*	*Mean Before Age 65*	*RD At 65*	*Mean Before Age 65*	*RD At 65*	*Mean Before Age 65*	*RD At 65*
Overall Sample	8.6	-2.0**	15.5	-3.6**	7.2	46.3**	20.2	38.2**
	(0.3)	[0.01]	(0.7)	[p<0.01]	(0.3)	[p<0.01]	(0.8)	[p<0.01]
		N=56,428		N=15,796		N=56,428		N=15,796
By Ethnicity:								
Whites	8.0	-2.0*	14.2	-3.0**	7.3	52.0**	20.9	40.3**
	(0.3)	[0.02]	(0.7)	[0.01]	(0.3)	[p<0.01]	(0.9)	[p<0.01]
		N=40,060		N=11,272		N=40,060		N=11272
Blacks	11.0	-1.6**	21.9	-7.3*	8.0	31.0**	21.3	29.8**
	(0.8)	[0.01]	(2.1)	[0.03]	(0.8)	[p<0.01]	(2.2)	[p<0.01]
		N=7,274		N=2,346		N=7,274		N=2,346
Hispanics	12.1	-4.7*	17.8	-4.7*	5.5	20.6**	12.0	27.3**
	(1.0)	[0.02]	(2.3)	[0.03]	(0.7)	[p<0.01]	(1.8)	[p<0.01]
		N=6,600		N=1,617		N=6,600		N=1,617
By Education:								
High school dropout	13.5	-4.8*	18.9	-3.6**	7.7	35.6**	23.7	29.3**
	(0.7)	[0.02]	(1.3)	[p<0.01]	(0.6)	[p<0.01]	(1.5)	[p<0.01]
		N=12,551		N=5,532		N=12,551		N=5,532
High school graduate	7.9	-2.2**	13.4	-3.1**	7.0	49.8**	19.8	41.0**
	(0.5)	[0.01]	(1.2)	[p<0.01]	(0.5)	[p<0.01]	(1.5)	[p<0.01]
		N=16,573		N=4,258		N=16,573		N=4,258
At least some college	7.2	-0.8	14.4	-4.3**	7.1	48.4**	18.2	43.2**
	(0.3)	[0.29]	(1.0)	[0.01]	(0.4)	[p<0.01]	(1.2)	[p<0.01]
		N=27,304		N=6,006		N=27,304		N=6,006

† All estimates were weighted to adjust for oversampling and the standard errors were clustered by age groups. Mean for respondents
‡ Mean for respondents age 60-64.
* Statistically significant at the 5% confidence level; ** Statistically significant at the 1% confidence level.



(a) White Non-Hispanics



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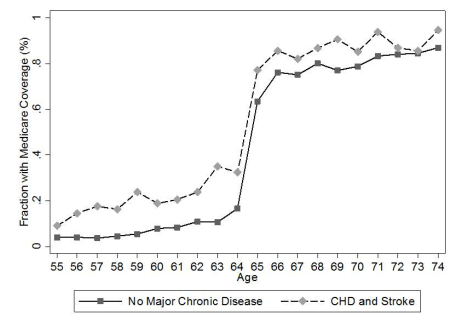
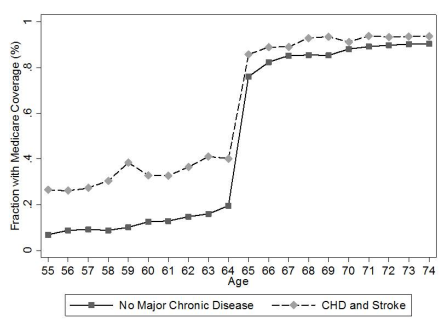
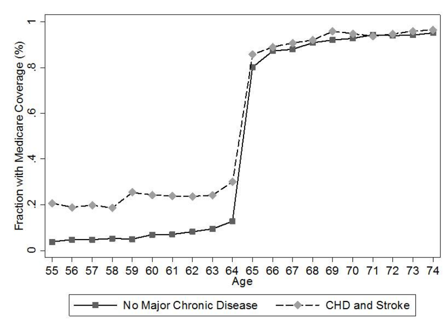


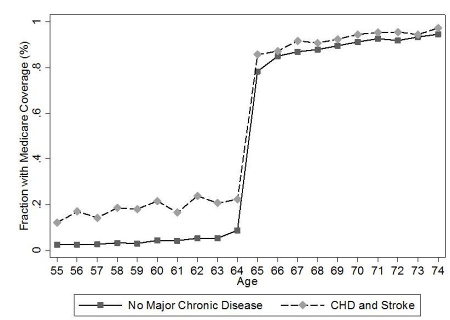
(c) Hispanics



(d) High School Dropouts



(e) High School Graduates



(f) With Some College Experience

Figure A.1 : Medicare coverage rates in respondents by age, health status, and race/education

Table A.1 : Sample Size

	Overall Sample		*By Education*					
			High School Dropout		*High School Graduate*		*At Least Some College*	
	No MCD	CHDS	No MCD	CHDS	No MCD	CHDS	No MCD	CHDS
Overall Sample	N=160,666	N=15,945	N=36,429	N=5,532	N=46,499	N=4,259	N=70,636	N=6,007
By Race/Ethnicity:								
			By Education and Race/Ethnicity					
Whites	N=110,830	N=11,358	N=16,942	N=3,196	N=34,786	N=3,367	N=54,840	N=4,709
Blacks	N=19,154	N=2,375	N=5,817	N=1,137	N=5,614	N=533	N=6,629	N=676
Hispanics	N=21,808	N=1,641	N=11,873	N=1,023	N=4,083	N=250	N=4,682	N=344

All values specified as percentages unless otherwise noted. MCD, major chronic disease; CHDS, coronary heart disease and stroke.

Table A.2 : RD estimates† at age 65 for office-based physician visits and emergency visits for adults diagnosed with coronary heart disease and stroke with p-values

	Office Visits (2+)		*Emergency Visits (2+)*	
	Heart Disease	*Stroke*	*Heart Disease*	*Stroke*
Overall Sample	1.6	1.1	1.6*	-0.2
	[0.13]	[0.29]	[0.04]	[0.56]
	N=15,543	N=15,543	N=15,633	N=15,633
By Ethnicity:				
Whites	1.4	0.4	2.7**	0.7
	[0.21]	[0.24]	[p<0.01]	[0.27]
	N=11,098	N=11,098	N=11,159	N=11,159
Blacks	-2.5	-1.9	-8.1*	-7.6
	[0.29]	[0.24]	[0.05]	[0.23]
	N=2,304	N=2,304	N=2,318	N=2,318
Hispanics	9.2*	10.4	-1.5	0.8
	[0.02]	[0.17]	[0.81]	[0.76]
	N=1,590	N=1,590	N=1,602	N=1,602
By Education:				
High school dropout	2.6	0.3	0.5	0.3
	[0.17]	[0.91]	[0.57]	[0.87]
	N=5,437	N=5,437	N=5,476	N=5,476
High school graduate	-0.6	0.2	2.2*	0.9
	[0.97]	[0.64]	[0.04]	[0.47]
	N=4,192	N=4,192	N=4,215	N=4,215
At least some college	2.3**	2.9**	1.3	-2.2**
	[0.01]	[p<0.01]	[0.27]	[0.01]
	N=5,914	N=5,914	N=5,942	N=5,942

† All estimates were weighted to adjust for oversampling and the standard errors were clustered by age groups. A stroke variable was included independently in the regression model and interacted with the regression discontinuity indicator variable. The linear combination of the two regression discontinuity terms gives an estimate of the impact of Medicare eligibility on health care use.
* Statistically significant at the 5% confidence level; ** Statistically significant at the 1% confidence level.

Table A.3 : RD estimates† at age 65 for office-based physician visits for adults diagnosed with coronary heart disease and stroke with p-values

	Dependent Variable: Office Based Visits (2+)		
	High School Dropouts	*High School Graduates*	*Reports at Least Some College*
Overall Sample	1.1	0.12	2.7**
	[0.40]	[0.90]	[0.01]
	N=15,576	N=15,576	N=15,576
By Ethnicity:			
Whites	-0.7	-0.3	2.5
	[0.67]	[0.79]	[0.06]
	N=11,125	N=11,125	N=11,125
Blacks	-2.7*	-1.3	-2.0**
	[0.03]	[0.41]	[0.01]
	N=2,307	N=2,307	N=2,307
Hispanics	9.0*	8.6	11.5**
	[0.05]	[0.20]	[0.01]
	N=1,592	N=1,592	N=1,592

† All estimates were weighted to adjust for oversampling and the standard errors were clustered by age groups. High school dropouts and respondents with some college experience are interacted with the regression discontinuity indicator variable. High school graduates are the excluded category. The linear combination of the regression discontinuity variable and the interacted high school dropout variable gives an estimate of the impact of Medicare eligibility on health care use among high school dropouts. The linear combination of the regression discontinuity variable and the interacted college experience variable gives an estimate of the impact of Medicare eligibility on health care use among respondents with at least some college experience.

* Statistically significant at the 5% confidence level; ** Statistically significant at the 1% confidence level.

Table A.4 : Robustness Checks

	Office Based Visits (1+)		*Office Based Visits (2+)*		*Financial Barriers*		*Supplemental Coverage*	
	No Major Chronic Disease	*Heart Disease and Stroke*	*No Major Chronic Disease*	*Heart Disease and Stroke*	*No Major Chronic Disease*	*Heart Disease and Stroke*	*No Major Chronic Disease*	*Heart Disease and Stroke*
Overall Sample								
a. Basic regression model	0.5	1.7*	0.9	1.4	-2.0**	-3.6**	46.3**	38.2**
(age 55-74)	[0.07]	[0.03]	[0.31]	[0.09]	[0.01]	[0.001]	[p<0.01]	[p<0.01]
	N=55,635	N=15,576	N=55,635	N=15,576	N=56,428	N=15,796	N=56,428	N=15,796
b. Limited controls model	0.3	1.6*	0.7	1.3	-2.0**	-3.3**	45.7**	37.6
(age, age^2, and year)	[0.37]	[0.03]	[0.34]	[0.12]	[0.01]	[p<0.01]	[p<0.01]	[p<0.01]
	N=56,288	N=15,711	N=56,288	N=15,711	N=57,184	N=15,945	N=57,184	N=15,945
c. Restricted age model	0.6	1.9	0.7**	0.8	-1.6**	-3.8**	44.8**	37.6**
(age 60-69)	[0.23]	[0.09]	[0.01]	[0.20]	[0.01]	[0.01]	[0.01]	[p<0.01]
	N=26,538	N=7,895	N=26,538	N=7,895	N=26,892	N=8,000	N=26,892	N=8,000
By Ethnicity								
Whites								
a. Basic regression model	0.2	1.3*	1.0	1.1	-2.0*	-3.0**	52.0**	40.3**
(age 55-74)	[0.08]	[0.02]	[0.42]	[0.16]	[0.02]	[0.01]	[p<0.01]	[p<0.01]
	N=39,543	N=11,125	N=39,543	N=11,125	N=40,060	N=11,272	N=40,060	N=11,272
b. Limited controls model	0.1	1.3*	0.8	1.0	-2.0**	-3.0**	51.6**	40.3**
(age, age^2, and year)	[0.70]	[0.02]	[0.43]	[0.20]	[0.01]	[0.01]	[p<0.01]	[p<0.01]
	N=39,911	N=11,204	N=39,911	N=11,204	N=40,493	N=11,358	N=40,493	N=11,358
c. Restricted age model	0.3	1.1	0.5	-0.2	-1.4	-2.8*	50.1**	39.8**
(age 60-69)	[0.24]	[0.24]	[0.18]	[0.55]	[0.06]	[0.03]	[0.01]	[p<0.01]
	N=18,929	N=5,640	N=18,929	N=5,640	N=19,167	N=5,710	N=19,167	N=5,710

† All estimates were weighted to adjust for oversampling and the standard errors were clustered by age groups.
* Statistically significant at the 5% confidence level; ** Statistically significant at the 1% confidence level.

Table A.4 : Robustness Checks (continued)

	Office Based Visits (1+)		*Office Based Visits (2+)*		*Financial Barriers*		*Supplemental Coverage*	
	No Major Chronic Disease	*Heart Disease and Stroke*	*No Major Chronic Disease*	*Heart Disease and Stroke*	*No Major Chronic Disease*	*Heart Disease and Stroke*	*No Major Chronic Disease*	*Heart Disease and Stroke*
Blacks								
a. Basic regression model	1.9	0.7	1.6	-2.1*	-1.6**	-7.3*	31.0**	29.8**
(age 55-74)	[0.10]	[0.29]	[0.37]	[0.05]	[0.01]	[0.03]	[p<0.01]	[p<0.01]
	N=7,133	N=2,307	N=7,133	N=2,307	N=7,274	N=2,346	N=7,274	N=2,346
b. Limited controls model	2.5	0.7	2.2	-2.2*	-1.9*	-7.4*	30.6**	29.0**
(age, age^2, and year)	[0.10]	[0.18]	[0.24]	[0.02]	[0.02]	[0.04]	[p<0.01]	[p<0.01]
	N=7,250	N=2,332	N=7,250	N=2,332	N=7,408	N=2,375	N=7,408	N=2,375
c. Restricted age model	4.5	0.7	4.8	-3.1	-0.4	-11.6*	29.8*	33.1*
(age 60-69)	[0.10]	[0.13]	[0.08]	[0.35]	[0.45]	[0.03]	[0.02]	[0.04]
	N=3,332	N=1,155	N=3,332	N=1,155	N=3,396	N=1,174	N=3,396	N=1,174
Hispanics								
a. Basic regression model	3.0	8.2	2.2	9.5*	-4.7*	-4.7*	20.6**	27.3**
(age 55-74)	[0.26]	[0.06]	[0.35]	[0.04]	[0.02]	[0.03]	[p<0.01]	[p<0.01]
	N=6,503	N=1,592	N=6,503	N=1,592	N=6,600	N=1,617	N=6,600	N=1,617
b. Limited controls model	2.5	8.1*	1.9	9.5*	-4.3*	-3.6	20.1**	27.8**
(age, age^2, and year)	[0.35]	[0.04]	[0.42]	[0.03]	[0.02]	[0.07]	[p<0.01]	[p<0.01]
	N=6,607	N=1,615	N=6,607	N=1,615	N=6,720	N=1,641	N=6,720	N=1,641
c. Restricted age model	3.9*	11.5**	1.7	15.2**	-7.0*	-4.8	21.3*	20.5
(age 60-69)	[0.04]	[0.01]	[0.32]	[p<0.01]	[0.04]	[0.17]	[0.03]	[0.08]
	N=3,111	N=816	N=3,111	N=816	N=3,149	N=826	N=3,149	N=826

† All estimates were weighted to adjust for oversampling and the standard errors were clustered by age groups.
* Statistically significant at the 5% confidence level; ** Statistically significant at the 1% confidence level.

Table A.4 : Robustness Checks (continued)

	Office Based Visits (1+)		*Office Based Visits (2+)*		*Financial Barriers*		*Supplemental Coverage*	
	No Major Chronic Disease	*Heart Disease and Stroke*	*No Major Chronic Disease*	*Heart Disease and Stroke*	*No Major Chronic Disease*	*Heart Disease and Stroke*	*No Major Chronic Disease*	*Heart Disease and Stroke*
By Education								
High School Dropouts								
a. Basic regression model	3.4*	1.9	2.4**	1.8	-4.8*	-3.6**	35.6**	29.3**
(age 55-74)	[0.05]	[0.25]	[0.01]	[0.34]	[0.02]	[p<0.01]	[p<0.01]	[p<0.01]
	N=12,371	N=5,453	N=12,371	N=5,453	N=12,551	N=5,532	N=12,551	N=5,532
b. Limited controls model	3.2*	1.8	2.1*	1.7	-4.8*	-3.6**	35.4**	28.9**
(age, age^2, and year)	[0.05]	[0.22]	[0.02]	[0.35]	[0.03]	[p<0.01]	[p<0.01]	[p<0.01]
	N=12,376	N=5,453	N=12,376	N=5,453	N=12,556	N=5,532	N=12,556	N=5,532
c. Restricted age model	5.0*	2.2	2.8	1.6	-4.1	-5.1*	37.3**	29.7*
(age 60-69)	[0.02]	[0.15]	[0.12]	[0.14]	[0.10]	[0.02]	[p<0.01]	[0.02]
	N=6,142	N=2,718	N=6,142	N=2,718	N=6,226	N=2,757	N=6,226	N=2,757
High School Graduates								
a. Basic regression model	-0.7	2.6**	1.4	0.1	-2.2**	-3.1**	49.8**	41.0**
(age 55-74)	[0.23]	[0.01]	[0.15]	[0.94]	[0.01]	[p<0.01]	[p<0.01]	[p<0.01]
	N=16,322	N=4,196	N=16,322	N=4,196	N=16,573	N=4,258	N=16,573	N=4,258
b. Limited controls model	-0.7	2.5**	1.5	0.04	-2.1**	-3.0**	49.6**	40.5**
(age, age^2, and year)	[0.28]	[0.01]	[0.10]	[0.97]	[0.01]	[p<0.01]	[p<0.01]	[p<0.01]
	N=16,324	N=4,197	N=16,324	N=4,197	N=16,575	N=4,259	N=16,575	N=4,259
c. Restricted age model	-1.1	0.5	-2.1**	-4.2	-1.4	-3.1	44.8**	40.8**
(age 60-69)	[0.21]	[0.63]	[0.01]	[0.12]	[0.10]	[0.16]	[0.01]	[0.01]
	N=7,953	N=2,178	N=7,953	N=2,178	N=8,059	N=2,207	N=8,059	N=2,207

† All estimates were weighted to adjust for oversampling and the standard errors were clustered by age groups.
* Statistically significant at the 5% confidence level; ** Statistically significant at the 1% confidence level.

Table A.4 : Robustness Checks (continued)

	Office Based Visits (1+)		*Office Based Visits (2+)*		*Financial Barriers*		*Supplemental Coverage*	
	No Major Chronic Disease	*Heart Disease and Stroke*	*No Major Chronic Disease*	*Heart Disease and Stroke*	*No Major Chronic Disease*	*Heart Disease and Stroke*	*No Major Chronic Disease*	*Heart Disease and Stroke*
At least some college								
a. Basic regression model	-0.1	1.0**	-0.1	2.2**	-0.8	-4.0**	48.4**	43.2**
(age 55-74)	[0.89]	[0.01]	[0.95]	[p<0.01]	[0.29]	[0.01]	[p<0.01]	[p<0.01]
	N=26,942	N=5,927	N=26,942	N=5,927	N=27,304	N=6,007	N=27,304	N=6,006
b. Limited controls model	-0.1	0.8*	-0.1	2.2**	-0.8	-4.0**	48.4**	42.9**
(age, age^2, and year)	[0.86]	[0.02]	[0.95]	[p<0.01]	[0.26]	[0.01]	[p<0.01]	[p<0.01]
	N=26,949	N=5,928	N=26,949	N=5,928	N=27,311	N=6,007	N=27,311	N=6,007
c. Restricted age model	0.03	3.1	1.8	4.3	-0.6	-4.5*	48.0**	40.6**
(age 60-69)	[0.86]	[0.14]	[0.06]	[0.06]	[0.43]	[0.02]	[0.01]	[0.01]
	N=12,443	N=2,999	N=12,443	N=2,999	N=12,607	N=3,036	N=12,607	N=3,036

† All estimates were weighted to adjust for oversampling and the standard errors were clustered by age groups.
* Statistically significant at the 5% confidence level; ** Statistically significant at the 1% confidence level.

Table A.5 : Sample Means† just before and after age 65 for office-based physician visits

	Dependent Variable: Office Based Visits (1+)				*Dependent Variable: Office Based Visits (2+)*			
	No Major Chronic Disease		*CHD and Stroke*		*No Major Chronic Disease*		*CHD and Stroke*	
	Mean Before Age 65 ‡	*Mean After Age 65* §	*Mean Before Age 65*	*Mean After Age 65*	*Mean Before Age 65*	*Mean After Age 65*	*Mean Before Age 65*	*Mean After Age 65*
Overall Sample	84.0	86.5	94.9	97.0	66.4	70.4	88.2	90.8
	(0.3)	(0.4)	(0.4)	(0.0)	(0.4)	(0.5)	(0.6)	(0.5)
By Ethnicity:								
Whites	85.6	87.5	95.3	97.2	67.7	71.3	88.6	91.1
	(0.4)	(0.4)	(0.5)	(0.3)	(0.5)	(0.6)	(0.7)	(0.6)
Blacks	81.2	84.9	95.7	97.0	66.1	70.5	90.4	90.5
	(1.1)	(1.1)	(0.9)	(0.7)	(1.3)	(1.4)	(1.7)	(1.4)
Hispanics	74.2	81.5	88.3	95.2	55.7	64.1	79.4	87.8
	(1.4)	(1.3)	(2.3)	(1.3)	(1.6)	(1.9)	(2.9)	(1.9)
By Education:								
High school dropout	76.0	81.8	93.7	96.0	60.5	66.4	86.9	89.8
	(0.9)	(0.9)	(0.9)	(0.5)	(1.0)	(1.1)	(1.2)	(0.9)
High school graduate	83.4	85.8	94.8	98.0	64.1	69.4	88.9	90.6
	(0.6)	(0.7)	(0.8)	(0.4)	(0.9)	(0.9)	(1.1)	(1.0)
At least some college	87.4	89.7	96.0	97.4	69.8	73.2	88.9	92.0
	(0.4)	(0.5)	(0.6)	(0.4)	(0.6)	(0.7)	(1.0)	(0.7)

† All means were weighted to adjust for oversampling. Mean differences for the two groups were generally significant at the 1% confidence level.

‡ Mean for respondents aged 60-64.

§ Mean for respondents aged 65-69.

Table A.6 : Sample Means† just before and after age 65 for access to care and supplemental coverage

	Dependent Variable: Access to Care				*Dependent Variable: Supplemental Coverage*			
	No Major Chronic Disease		*CHD and Stroke*		*No Major Chronic Disease*		*CHD and Stroke*	
	Mean Before Age 65 ‡	*Mean After Age 65* §	*Mean Before Age 65*	*Mean After Age 65*	*Mean Before Age 65*	*Mean After Age 65*	*Mean Before Age 65*	*Mean After Age 65*
Overall Sample	8.6	4.8	15.5	9.0	7.2	57.5	20.2	63.7
	(0.3)	(0.2)	(0.7)	(0.5)	(0.3)	(0.5)	(0.8)	(0.9)
By Ethnicity:								
Whites	8.0	4.2	14.2	8.4	7.3	63.4	20.9	66.9
	(0.3)	(0.2)	(0.7)	(0.5)	(0.3)	(0.6)	(0.9)	(1.0)
Blacks	11.0	6.4	21.9	11.8	8.0	41.5	21.3	53.9
	(0.8)	(0.7)	(2.1)	(1.4)	(0.8)	(1.5)	(2.2)	(2.3)
Hispanics	12.1	7.8	17.8	11.7	5.5	31.3	12.0	43.7
	(1.0)	(0.9)	(2.3)	(0.9)	(0.7)	(1.5)	(1.8)	(2.8)
By Education:								
High school dropout	13.5	7.3	18.9	11.9	7.7	47.6	23.7	57.8
	(0.7)	(0.5)	(1.3)	(0.9)	(0.6)	(1.1)	(1.5)	(1.5)
High school graduate	7.9	3.8	13.4	7.9	7.0	61.2	19.8	67.1
	(0.5)	(0.3)	(1.2)	(0.9)	(0.5)	(0.9)	(1.5)	(1.6)
At least some college	7.2	4.4	14.4	7.3	7.1	60.5	18.2	66.7
	(0.3)	(0.3)	(1.0)	(0.7)	(0.4)	(0.8)	(1.2)	(1.4)

† All means were weighted to adjust for oversampling. Mean differences for the two groups were generally significant at the 1% confidence level.

‡ Mean for respondents aged 60-64.

§ Mean for respondents aged 65-69.

Table A.7 : RD estimates† at age 65 for emergency visits with p-values and sample size

	Dependent Variable: Emergency visits (1+)				*Dependent Variable: Emergency visits (2+)*			
	No Major Chronic Disease		*CHD and Stroke*		*No Major Chronic Disease*		*CHD and Stroke*	
	Mean Before Age 65 ‡	*RD At 65*	*Mean Before Age 65*	*RD At 65*	*Mean Before Age 65*	*RD At 65*	*Mean Before Age 65*	*RD At 65*
Overall Sample	13.1	-0.6	33.9	0.8	3.4	-0.1	14.9	1.1
	(0.3)	[0.22]	(0.9)	[0.44]	(0.2)	[0.80]	(0.7)	[0.07]
		N=55,926		N=15,667		N=55,926		N=15,667
By Ethnicity:								
Whites	12.7	-0.7	31.1	2.0*	3.0	0.2	12.8	2.1**
	(0.4)	[0.19]	(1.0)	[0.04]	(0.2)	[0.59]	(0.7)	[p<0.01]
		N=39,730		N=11,186		N=39,730		N=11,186
Blacks	17.2	-0.1	51.1	-11.4**	6.8	-2.5**	26.9	-7.7
	(1.0)	[0.93]	(2.6)	[0.01]	(0.7)	[p<0.01]	(2.4)	[0.12]
		N=7,191		N=2,321		N=7,191		N=2,321
Hispanics	13.7	-0.5	39.4	3.8	4.5	-1.1	20.2	-0.6
	(1.0)	[0.28]	(3.2)	[0.60]	(0.6)	[0.06]	(2.6)	[0.91]
		N=6,533		N=1,605		N=6,533		N=1,605
By Education:								
High school dropout	15.8	-1.0	40.2	-0.04	5.4	-0.01	20.5	0.6
	(0.8)	[0.40]	(1.7)	[0.98]	(0.5)	[0.99]	(1.4)	[0.63]
		N=12,449		N=5,492		N=12,449		N=5,492
High school graduate	11.8	0.03	31.1	3.0*	3.2	0.1	13.8	1.9**
	(0.6)	[0.93]	(1.7)	[0.04]	(0.4)	[0.76]	(1.2)	[0.01]
		N=16,415		N=4,219		N=16,415		N=4,219
At least some college	12.9	-1.0*	31.6	-0.5	2.8	-0.3	11.8	0.2
	(0.4)	[0.05]	(1.4)	[0.70]	(0.2)	[0.29]	(1.0)	[0.79]
		N=27,062		N=5,956		N=27,062		N=5,956

† All estimates were weighted to adjust for oversampling and the standard errors were clustered by age groups.
‡ Mean for respondents age 60-64.
* Statistically significant at the 5% confidence level; ** Statistically significant at the 1% confidence level.

Table A.8 : RD estimates[†] at age 65 for office-based physician visits after controlling for employment status with p-values and sample size

	Office Visits (1+)		*Office Visits (2+)*	
	No Major Chronic Disease	*Coronary Heart Disease and Stroke*	*No Major Chronic Disease*	*Coronary Heart Disease and Stroke*
Overall Sample	0.3	1.6*	0.4	1.0
	[0.20]	[0.05]	[0.60]	[0.23]
	N=55,280	N=15,516	N=55,280	N=15,516
By Ethnicity:				
Whites	0.1*	1.3*	0.5	0.8
	[0.05]	[0.04]	[0.63]	[0.33]
	N=39,329	N=11,086	N=39,329	N=11,086
Blacks	1.6	0.9	0.7	-2.8**
	[0.18]	[0.21]	[0.66]	[0.01]
	N=7,070	N=2,299	N=7,070	N=2,299
Hispanics	2.6	8.0	1.3	8.7
	[0.33]	[0.06]	[0.61]	[0.06]
	N=6,452	N=1,580	N=6,452	N=1,580
By Education:				
High school dropout	3.0	1.8	1.2*	1.4
	[0.09]	[0.26]	[0.03]	[0.44]
	N=12,291	N=5,430	N=12,291	N=5,430
High school graduate	-0.9	2.6*	0.8	-0.3
	[0.20]	[0.01]	[0.26]	[0.80]
	N=16,231	N=4,182	N=16,231	N=4,182
At least some college	-0.2	0.8	-0.4	2.0**
	[0.77]	[0.06]	[0.80]	[0.01]
	N=26,758	N=5,904	N=26,758	N=5,904

† All estimates were weighted to adjust for oversampling and the standard errors were clustered by age groups. Employment status was included as an additional control in this specification.
* Statistically significant at the 5% confidence level; ** Statistically significant at the 1% confidence level.

Chapter 2

The Managed Care Backlash and Hospital Cost Containment

2.1 Introduction

Recent years have witnessed large changes in the organization, financing, and delivery of healthcare in the U.S. as Americans have shifted away from traditional insurance and into managed care plans. Researchers largely attributed this shift to managed care's ability to address market failures associated with patients "shopping" for medical care.[1] Consumer dissatisfaction with the quality and limitations of managed care has led to rapid disenrollment from managed care plans and demand for regulation between 1998 and 2003. Managed care plans now face quality and coverage mandates that restrict them from using their most aggressive cost controls. This has led many to question managed care's ability to curb medical cost growth.

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[1]The "shopping problem" refers generally to the market failures which occur as a result of consumers relying on healthcare providers to advise them on treatment (Dranove, 2000). Under a traditional insurance environment, where medical services are unbundled and reimbursed separately on a fee-for-service basis, healthcare providers have an incentive to prescribe unnecessary or marginally beneficial treatments to patients since their profits are linked to volume. To address this issue, indemnity plans rely on patient cost sharing (i.e., copayments, deductibles) to limit the consumer's demand for healthcare services. Unlike indemnity plans which focus on patient cost sharing, managed care uses provider incentives (i.e., selective contracting, capitation, gatekeeping) to curb the provision of healthcare services.

Past studies have examined the effects of managed care penetration on Medicare expenditures (Baker and Courts, 1996; Baker, 1997; Chernew et al., 2008), as well as the impact of increased managed care penetration on overall market activity with positive results(Robinson 1991, 1996; Melnick and Zwanziger, 1995; Gaskin and Hadley, 1997; Bamezai et al. 1999; Shen and Melnick, 2004). More recently, researchers have focused their attention to examining managed care's ability to contain costs since the managed care backlash (Shen and Melnick, 2006; Dranove et al., 2008; Konetzka et al., 2008; Shen, Wu, and Melnick, 2010); however, these studies may not fully control for the potential endogeneity of HMO penetration with respect to provider costs.[2]

This paper examines the extent to which this backlash affected managed care's ability to contain hospital costs among short-term, non-federal hospitals between 1998 and 2008. This time period is an ideal environment to test whether cost containment varies with increased managed care activity because it overlaps with both the managed care backlash period (1998-2003) and the post-backlash period (2004-2008). My analysis focuses on HMOs, the most aggressive managed care model. Unlike previous studies that use cross-sectional or fixed effects estimators to address the endogeneity of HMO penetration with respect to hospital costs, this study uses a fixed effects instrumental variable (IV) approach.

[2]Shen and Melnick (2006) and Shen, Wu, and Melnick (2010) are the exceptions as they report instrumental variables (IV) results or offer explanations for not using IV. Shen, Wu, and Melnick (2010) suggest previous instruments (i.e., labor market characteristics) might have been valid instruments during managed care's growth period, but current changes in HMOs are more likely driven by consumer demand factors related to consumer experiences with HMOs and the backlash.

The results suggest two conclusions. First, I found that the impact of increased HMO penetration on total hospital costs declined over the study period. Specifically, a 10% increase in HMO penetration was associated with a 0.3% decline in total costs during the backlash. Post-backlash, the same 10% increase was associated with a 0.6% increase in total costs. After adjusting for endogeneity, these results were insignificant. Second, the unit cost analysis revealed a similar decline in cost containment over the study period; however, a reversal did not occur for outpatient costs. The IV results showed that a 10% increase in HMO penetration resulted in a statistically significant 2.0% increase in inpatient costs per discharge and an 8.1% decline in outpatient costs per visit. Post-backlash, the same 10% increase in HMO penetration was associated with an 8.0% increase in inpatient costs per discharge and a 5.5% decline in outpatient costs per visit. Although managed care's ability to contain hospital costs appears to have declined over the study period, these results suggest that HMOs are still a valuable cost containment device for outpatient services.

The remainder of this paper is organized as follows. Section 2.2 reviews the literature and Section 2.3 presents the conceptual framework. The econometric framework is presented in Section 2.4. The data are summarized in Section 2.5 and the results are presented in Section 2.6. The final sections conclude and discuss policy implications.

2.2 Background

2.2.1 Managed Care and Cost Containment

A substantial empirical literature has found that managed care enrollees have lower costs and utilization as compared to traditional indemnity insurance enrollees (Miller and Luft, 1994, 1997, 2002). In addition, increased managed care activity has been found to impact overall market activity through three main channels: slowing the diffusion of technology (Mas and Seinfeld, 2008; Bokhari, 2009), impacting the level and quality of hospital staffing (Mark, Harless, and McCue, 2005), and altering medical practice patterns that affects both managed care and non-managed care enrollees (Baker 1997, 1999; Baker and Courts, 1996; Baker and McClellan, 2001; Heidenreich et al., 2002; Bradford and Krumholz, 2003; Chernew, DeCicca, and Town, 2008).

Researchers have estimated managed care's impact on medical expenditures with varying results. For example, Baker and his coauthors examine the impact of Medicare HMO penetration on fee-for-service (FFS) healthcare expenditures using data from the late 1980s and early 1990s (Baker, 1997, 1999; Baker and Shankarkumar, 1997). Using data from 1990-1994, Baker and Shankarkumar (1997) show that a 10% increase in Medicare HMO market share (from 10% to 20% HMO market share) resulted in a 2% decline in expenditures. Their IV results suggested an even higher level of cost containment. A recent study by Chernew, DeCicca, and Town (2008) use data from 1994-2001 and IV to show that a 1% increase in county-level Medicare HMO penetration is associated with nearly a 1% reduction in annual spending.

2.2.2 The Managed Care Backlash

An important development in healthcare in the U.S. is the substitution of indemnity insurance plans for managed care arrangements such as HMOs and preferred provider organizations (PPOs). Researchers attribute the rise of managed care, in particular HMOs, to their use of provider incentives to resolve market failures related to "the shopping" problem. Over time, concerns about the quality and limitations of managed care led to widespread distrust among consumers and policymakers. According to Figure 1, HMO and Medicare Advantage (MA) enrollments fell from 21% and 13% to 17% and 9% between 1998 and 2003, respectively. Any willing provider and freedom of choice laws passed during this time period allowed providers who met minimum standards to be eligible to treat HMO enrollees, limited managed care's ability to use selective contracting to negotiate profitable reimbursement rates, and allowed consumers to choose their own providers. Both the decline in enrollment and passage of managed care regulation between 1998 and 2003 has been labeled as a backlash in response to HMO efforts to restrict utilization of healthcare services using provider incentives.[3] Recently, researchers have focused their attention to measuring managed care's ability to contain provider cost since the backlash (Shen and Melnick, 2006; Dranove et al, 2008; Konetzka et al., 2008; Shen, Wu, and Melnick, 2010).

[3]Also during this backlash, less restrictive forms of managed care (i.e., PPOs) flourished, state governments passed consumer and provider protection regulation that opened hospital networks and imposed minimum coverage standards, and increased hospital bargaining power limited managed care's position in contract negotiations (Shen and Melnick, 2006).

In one of the most comprehensive studies to date, Shen, Wu, and Melnick (2010) find that a 10% increase in HMO enrollment was associated with a 4.1% reduction in total operating costs from 1994 to 1999. This time period, defined as the pre-backlash period, also showed that markets with low HMO penetration had a 10% increase in HMO enrollments, resulting in a 5.5% reduction in costs. In markets with high penetration, a 10% increase in HMO enrollments results in a 5% drop in operating cost. Between 2000 and 2005, the time period defined as the post-backlash period, a 10% rise in HMO penetration was associated with a 2.5% decline in operating costs among hospitals.

Previous studies have documented a decline in HMOs' ability to contain costs since the late 1990s, but these studies have been unable to determine the post backlash performance of HMOs due to the lack of data (Shen and Melnick, 2004, 2006; Konetzka et al., 2008; Dranove et al., 2008; Shen, Wu, and Melnick, 2010). The analysis of total hospital costs provide broad descriptions of overall hospital performance, but knowledge of unit costs is required for planning budgets, measuring efficiency, and establishing a schedule of charges for patient services (Shepard, Hodgkin, and Anthony, 2000; Friedman, Wong, and Steiner, 2006). To date, the analysis of HMOs' impact on hospital unit costs has been sparse (Konetzka et al., 2008). Understanding HMOs' ability to contain costs is important for understanding HMOs' impact on overall hospital performance, the efficiency of health interventions, and the continuing role HMOs should play in future hospital cost containment policy.

2.3 Conceptual Framework

2.3.1 Hospital Cost Model

Hospital costs may be viewed as a function of many factors: service volume, quality of service, scope of services, factor prices, and production efficiency.[4] In general, total hospital costs $TotalCosts$ can be summarized by the following reduced form equation:

$$TotalCosts = \sum_{i=0}^{n} c_{ijk}(Volume_{ij}, Wages_{ij}, HMOPen_k, X_{ij}) + \epsilon \tag{2.1}$$

where c represents the cost of hospital service i at hospital j in county k. *Volume* represents volume for hospital service i. *Wages* represents hospital wages. *HMOPen* represents the fraction of the county population enrolled in a managed care plan. Let X represent other characteristics which affect the cost of care. Last, ϵ is a disturbance term. Equation (2.1) will be used to estimate the impact of the backlash on managed care's ability to contain hospital costs.

Managed care promotes efficiency in a number of ways. As part of the selective contracting process, HMOs exchange patient volume to negotiate lower prices from providers. As a consequence, a cost advantage may result from scale economies generated from increased patient volume. Provisions that use primary care physicians as a gatekeeper to authorize the use of healthcare services limit overall utilization, especially the use of medical hospital services. In addition, increased HMO activity

[4] Studies that examine hospital cost and production efficiency typically utilize a cost function analysis; however, estimating a cost function for hospitals is complicated by a lack of data on capital factors (Jensen and Morrisey, 1986; Zwanziger and Melnick, 1988). Following others, I estimate a reduced form cost equation using a wage index that relates each hospital's local hourly wages to national averages (Shen and Melnick, 2006; Konetska et al., 2008; Shen, Wu, and Melnick, 2010).

at the market level can stimulate price competition among providers in order to negotiate lower prices (Baker, 1997; Konetska et al., 2008; Shen, Wu, and Melnick, 2010), limit the diffusion of expensive medical technology which can impact the intensity of hospital service (Mas and Seinfeld, 2008; Bokhari, 2009), and impact the level and quality of hospital staffing (Mark, Harless, and McCue, 2005).

2.3.2 Estimation Issues

There are several issues to be considered when estimating the cost equation, eq. (2.1). First, there may be unobservable factors that are correlated with both HMO penetration and hospital costs. For example, since HMOs base their entry decisions and activity level on hospital cost growth, the use of any HMO penetration measure may result in biased estimates of the impact of increased HMO penetration on hospital costs.[5] A second challenge to interpreting the empirical results is the timing of the managed care backlash. Marquis, Rogowski and Escarce (2004) identify the beginning of the managed care backlash period as 1998. A later study by Konetzka et al. (2008) identifies the post-backlash period as beginning in 1997. Yet another study by Shen, Wu, and Melnick (2010) select the year 2000 as the beginning of the managed care backlash. Last, the limited availability of good data on managed care means that the largest component of managed care (e.g., PPOs) are not controlled for in most analyses (Bamezai et al., 1999; Shen, Wu, Melnick, 2008).

[5]Other sources of endogeneity may be considered. For example, hospital consolidations may decrease HMO activity and increase hospital costs (Chernew et al., 2008). On the other hand, preferences of patients and providers for conservative care might increase HMO activity and decrease hospital costs (Baker, 1997).

2.4 Econometric Framework

2.4.1 Basic Model

The conceptual framework suggests that the impact of increased HMO penetration on hospital costs may decline following the backlash, however, the exact magnitude of the backlash is ambiguous. Accordingly, I estimate fixed effects models of the following form:

$$Log(TotalCosts)_{jkt} = \alpha_j + \gamma_t + \beta_1 HMOPen_{kt} + \beta_2 B_t \times HMOPen_{kt} + \beta_3 X_{jt} + \mu_{jkt} \quad (2.2)$$

where $TotalCosts$ represents total hospital accounting costs of hospital j located in county k in time period t.[6] $HMOPen$ represents the fraction of individuals enrolled in an HMO in county c in year t. α_j represent unobservable effects that vary by hospital and γ_t represent time fixed-effects. B_t is an indicator variable that takes on a value of 1 after 2004. X_{jt} represents observable characteristics of hospital j in period t. These include hospital volumes (e.g., inpatient discharges, outpatient visits), capacity, wages, case mix, organizational structure, patient distribution (e.g., Medicare, Medicaid), and variables correlated with the demand for hospital services (e.g., per capita income). Last, μ_{jkt} is a disturbance term.

[6]Hospital costs are also decomposed into unit costs by hospital service (i.e., inpatient costs per discharge and outpatient costs per visit). To date, the analysis of HMOs' impact on costs by hospital service has been sparse: Baker (1997, 1999) examines aggregate Medicare Part A & B expenditures while Konetzka et al. (2008) examine outpatient units. This study represents an improvement over earlier studies due to its assessment of managed care's impact on total and unit costs.

The coefficient β_1 in eq. (2.2) captures the effect of HMO penetration on hospital cost during the backlash period (1998-2003). The coefficient β_2 is an interaction term between the post-backlash indicator and HMO penetration. The linear combination of β_1 and β_2 captures the effect of managed care penetration on hospital cost in the post-backlash period (2004-2008). Following others (Baker, 1997; Shen, Wu, and Melnick, 2010), the reported regression coefficients were adjusted to reflect a 10% increase in managed care penetration. Therefore, the impact of a 10% increase in HMO penetration on hospital costs during the backlash (1998-2003) is captured by regression coefficient β_1 in eq. (2.2) and the impact of a 10% increase in HMO penetration on hospital costs during post-backlash (2004-2008) is captured by the linear combination of β_1 and β_2 in eq. (2.2).

2.4.2 Instrumental Variables

Since HMO penetration and hospital costs are potentially endogenous, the fixed effects model described in eq. (2.2) will not render consistent estimates for β_1 and β_2. To identify the effect of increased HMO penetration on hospital costs, I use fixed effects IV estimation.[7] The fixed effects IV model is identified by four exclusion restrictions: state "any willing provider" laws, state "freedom of choice" laws, the unemployment rate, and firms with 25 or more employees are assumed to directly affect HMO penetration but not hospital costs.

[7] With a standard exogeneity assumption, i.e. $E(u_{it}|a_i, b_i) = 0$, Wooldridge (2005) shows that the fixed effects estimator consistently estimates the population parameter. If this assumption does not hold, but an appropriate set of instruments can be found, i.e. $E(u_{it}|z_i, a_i, b_i) = 0$, Murtazashvili and Wooldridge (2008) show that the fixed effects IV estimator is consistent.

The first stage effect of regulation on HMO penetration is possible because the passage or reform "any willing provider" and "freedom of choice" laws limited managed care's ability to negotiate profitable reimbursement rates. Therefore, the passage and reform of managed care regulation would disproportionally impact MCOs that rely heavily on selective contracting and gatekeeping to contain costs (i.e., HMOs), but would benefit more lenient forms of managed care (i.e., PPOs).[8]

The HMO Act of 1997 requires employers who offered health care benefits to offer managed care plans as an alternative to indemnity insurance. Employers who meet the following criteria fall under this Act: having 25 or more employees, are within the service area of a federally qualified HMO, are paying at least minimum wage, and offer a health plan to their employees. The county-level unemployment rate is used as an instrument for HMO penetration, because most individuals in the U.S. receive their insurance through an employer, and most employers offer some form of managed care insurance as a consequence of the HMO Act of 1973.[9]

[8] Appendix Table B.1 reports the results of the impact instruments on the log managed care plans. The passage or reform of an "any willing provider" or "freedom of choice" law had a negative impact on the number of HMO plans: the fraction of HMO plans declined 8.3% and 9.7%, respectively. As expected, the passage of an "any willing provider" law had no effect on the number of PPO plans, but the passage of a "freedom of choice" law lead to a 19.5% increase in the fraction of PPO plans.

[9] Although the "dual choice" provision was removed by 1995, the first stage regression results presented in Appendix Table B.1 suggest the two labor market instruments are still significant determinants of HMO penetration.

2.5 The Data

2.5.1 Hospital Costs

Hospital costs among all short-term, non-federal hospitals in the U.S. were calculated using accounting data from the Centers for Medicare and Medicaid Studies (CMS) Hospital Cost Reports. The base year for the study is 1998, the beginning of the backlash, and the final years is 2008, the most recent year comprehensive data are available. Hospital costs were adjusted to reflect 2008 dollars using the U.S. Bureau of Labor Statistics Consumer Price Index (CPI). Observations were designated as outliers if (1) they fell below the 1^{st} percentile or above the 99^{th} percentile or (2) their year-to-year growth fell below the 1^{st} or above the 99^{th} percentile.

Unit costs by hospital service were also calculated. First, total hospital costs were decomposed into service costs by multiplying total inpatient (outpatient) charges by the hospital's annual cost-to-charge ratio, respectively. Next, total service costs were divided by total inpatient discharges and total outpatient visits, respectively. According to Table 2.1, mean total hospital costs, inpatient costs per discharge, and outpatient costs per visit were $90.2 million, $7198.4, and $308.6 in 1998, respectively. Between 1999 - 2003, hospital costs grew at an accelerated rate. By 2004, cost growth had slowed and declined between 2004 - 2007. Outpatient cost growth remained high.

2.5.2 Managed Care Penetration

Managed care penetration rates were calculated using HMO enrollment data from HealthLeaders Interstudy. Hospital markets are defined at the county level. Therefore, HMO penetration is defined as the proportion of the county's population enrolled in a private or public (i.e., Medicare, Medicaid) HMO plan. According to Table 2.1, mean HMO penetration was 21.3% in 1998, declined between 1999 and 2003, and by 2004 reversed their decline. However, by 2008 HMO penetration was 16.8%.

2.5.3 Instrumental Variables

As mentioned before, employers who meet the following criteria fall under the HMO Act of 1973: having 25 or more employees, are within the service area of a federally qualified HMO, are paying at least minimum wage, and offer a indemnity health plan to their employees. Due to the categorical nature of the County Business Patterns File, the fraction of companies with 20 or more employees was used. County-level unemployment rates are obtained from the Area Resource File (ARF). Data on passage of state-level "any willing provider" and "freedom of choice" regulation were obtained from the National Council of State Legislatures' State Laws Report.

2.5.4 Hospital Market Power

The hospital's bargaining position is an important determinate of the negotiated reimbursement rates between HMOs and hospitals. In this study, the degree of competition faced by each hospital was calculated as a Herfindahl Index, the sum of squared market shares. Hospital bargaining power is based on hospital discharges from the American Hospital Association Annual Surveys.

2.5.5 Other Controls

Other control variables include hospital ownership, bed counts, teaching status, CMS case mix, Medicare and Medicaid share of discharges, total inpatient discharges, total inpatient discharges squared, total outpatient visits, and total outpatient visits squared. Real per capita income, adjusted to reflect 2008 dollars using the U.S. Bureau of Labor Statistics CPI, is included to control for medical demand. The CMS Wage Index proxies for labor input prices. Table 2.2 summarizes these variables.

2.6 Results

2.6.1 Hospital Cost Estimates

Table 2.3 presents the main results from the fixed effects and IV models estimating the impact of HMO penetration on hospital costs. After controlling for covariates, a finding that the coefficient β_1 (or the combination $\beta_1 + \beta_2$) from eq. (2.2) are negative are consistent with the hypothesis that hospitals are generally responding to HMO cost containment efforts during the backlash (post-backlash) period, respectively.

The fixed effects estimates are reported in the first three columns of Table 2.3. Overall, a 10% increase in HMO penetration is associated with a statistically significant 0.3% reduction in total hospital cost, a 0.4% reduction in inpatient costs per discharge, and a 1.9% reduction in outpatient costs per visit during the managed care backlash period. Post-backlash, there is no measurable amount of cost containment for total hospital costs and inpatient costs per discharge: the same 10% increase in HMO penetration was associated with a 0.6% increase in total hospital cost and a 1.3% increase in inpatient costs per discharge. Compared to inpatient cost results, there was a modest decline in HMOs' impact on outpatient costs.

The next three columns in Table 2.3 report the IV estimates. During the backlash and post-backlash periods there was no measurable, statistically significant amount of cost containment for total hospital costs.[10] Overall, the unit cost analyses showed that a 10% increase in HMO penetration resulted in a 2.0% increase in inpatient costs per discharge and an 8.1% decline in outpatient costs per visit. Post-backlash, the same 10% increase in HMO penetration was associated with an 8.0% increase in inpatient costs per discharge and a 5.5% decline in outpatient costs per visit.

2.6.2 Alternative Specifications

The results of two alternative specifications are reported in Table 2.4. First, to test the robustness of the results to alternative measures of managed care penetration, models that include both HMO penetration and MA penetration were estimated. While MA penetration does not measure overall PPO penetration, it is the best measure of overall managed care penetration available. These results are similar to the fixed effects results. Second, to verify missing observations are not driving the

[10] Appendix Table B.2 reports the first stage results. There are different first stage estimates for each regression since the sample size varies for each cost measure. The instruments are jointly significant at the 1% significance level. In addition, the signs of the coefficients of the instruments were strong and statistically significant at the 1% significance level for each cost measure. In particular, the passage of an "any willing provider" ("freedom of choice") law results in a 2% decline (4% increase) in HMO penetration, respectively. A 1% increase in county unemployment results in a 0.7% decline in HMO penetration and a 1% increase in the fraction of firms with 20 or more employees results in a 1.7% increase in HMO penetration.

results, models that include hospitals present throughout the entire study period are estimated.[11] These results are consistent with the main results.

2.7 Discussion

The previous section presented estimates of the impact of the backlash on HMOs ability to contain hospital costs. Two estimators and three cost models were used, but all estimates suggest the same conclusion: the impact of increased HMO penetration on costs declined over the study period. These results are interesting for two reasons. The first is that the IV estimates are larger than the fixed effects estimates. The second is that the impact of HMO penetration on inpatient costs reversed over the study period, but HMOs were still effective at containing outpatient costs.

2.7.1 Larger IV Estimates

Relative to the fixed effects results, the IV estimates point to a larger effect of increased HMO penetration on hospital costs. This may be due to several reasons. First, although the IV estimates are significantly significant different from zero, it is unclear whether they are statistically different from the fixed effects estimates. If HMO penetration is not endogenous, the fixed effects estimates are preferred since the estimator has lower variance. This is unlikely the case since the results of the Durbin-Wu-Hausman tests for the inpatient and outpatient models rejects the null

[11] In addition, I test the data for unit roots using the Levin, Lin, and Chu (2002) panel unit root test, where the null hypothesis is that all the panels contain a unit root (Appendix Table B.3). In each model the Levin-Lin-Chu test rejects the null hypothesis that the panels contain unit roots.

hypothesis that the fixed effects and IV estimates are the same (Table 2.3). The hypothesis is just barely accepted for the total cost model.

Second, it may be the case that some instruments may be correlated with hospital costs, thus violating our exclusion restrictions in a way that biases the estimates upward. Several identification tests are utilized to investigate the validity of the instruments (Table 2.3). The Hansen J-test tests if the over-identifying restrictions are valid, where the null is that the instruments are uncorrelated with the error term. A failure to reject the null hypothesis implies that the instruments are exogenous. The Hansen J-test for each model fail to reject the null hypothesis that the over-identifying instruments are invalid. Because there are more instruments than the number of potentially endogenous variables, we can test over-identifying restrictions. The Kleibergen-Paap (KP) Lagrange Multiplier (LM) test tests for under-identification and the KP Wald F-test tests for weak identification. The KP LM statistic for each model rejects the null that the model is under-identified and the KP Wald F-test for each model rejects the null that the instrumental variables are weak.

Last, since hospital networks allow patients to seek care at hospitals located outside their county of residence, HMO penetration measures based on county HMO enrollments only will underestimate actual HMO activity. In the presence of this type of measurement error, the fixed effects results are biased towards zero.

2.7.2 Differential Impact on Costs

It comes at no surprise that HMOs are effective at controlling outpatient costs as the waste associated with the delivery of outpatient care is well documented (McKinsey Global Institute, 2008). It is unclear why there was a reversal for inpatient care. There are a several possible explanations for the inpatient costs result.

First, rising inpatient costs may be partially due to increased use of expensive technology, higher labor costs, and hospital consolidation. For example, Friedman, Wong and Steiner (2006) used discharge data for the nine leading groups of admissions from 1998 to 2001 and found that increased HMO penetration restrained admission rates, but neither the initial level nor the change in the HMO market penetration had a significant association with inpatient costs.[12] Second, mandated expansions of benefits during the backlash may result in a less healthy, more costly mix of members through adverse selection (Mays, Hurley, and Grossman, 2003).

On the other hand, benefit expansions can increase demand for medical care, and thus increase costs. Goldman et al. (1995) use survey and claims data to examine the cost implications of the Department of Defense's decision to replace a traditional FFS policy with two managed care alternatives. A notable feature of the new health policy was the decision to expand the benefits available to military health care beneficiaries. They found that utilization and medical costs, both inpatient and outpatient costs, were higher under the new managed care policy compared to the old FFS policy.

[12] Admissions: acute myocardial infarction; coronary atherosclerosis; complication of device, implant, or graft; spondylosis, intervertebral disc disorders; cardiac dysrhythmias; osteoarthritis; respiratory failure, insufficiency; congestive heart failure, nonhypertensive; and nonspecific chest pain.

2.8 Conclusion

The expensive and rising level of healthcare spending in the U.S. has led to sustained interest in developing institutions for addressing the cost drivers of healthcare delivery. Managed care's use of provider incentives to address the "shopping problem" represented a major step in controlling runaway medical cost growth throughout the 1980s and early 1990s. Unfortunately, consumer dissatisfaction with the quality and limitations of managed care led to an organized backlash against managed care. Following this backlash, MCOs, particularly HMOs, now face quality and coverage mandates which restrict them from using their most aggressive cost controls. Previous studies have documented a decline in HMOs' ability to contain costs since the backlash; however, these studies are complicated by a lack of data and endogeneity.

The goal of this paper has been to address these limitations using current data and the regulatory backlash against managed care as a source of identifying variation in my hospital cost models. The fixed effects results suggest modest cost savings, with a reversal in cost containment following the backlash. On the other hand, the unit cost and IV results show some interesting results. In particular, HMOs were still effective at containing outpatient costs, although the impact of increased HMO penetration on inpatient costs reversed over the study period.

The negative impact of the backlash on managed care's ability to contain hospital costs may have important policy implications. For instance, an important policy question is to what extent Accountable Care Organizations (ACOs) may slow cost growth. ACOs are the latest wave of cost containment institutions and vary from

MCOs in their structure (Gold, 2010); however, both MCOs and ACOs rely on the same provider incentives to lower costs and improve efficiency. Given that the aggressive use of provider incentives led to a backlash against managed care in the late 1990s, too much focus on provider incentives in ACOs could result in a similar backlash (Tollen and Crane, 2002).

Further work should focus on understanding the backlash's impact on quality, looking at patients by diagnosis group and considering how the backlash impacted their treatment patterns, adherence behavior, and survival.

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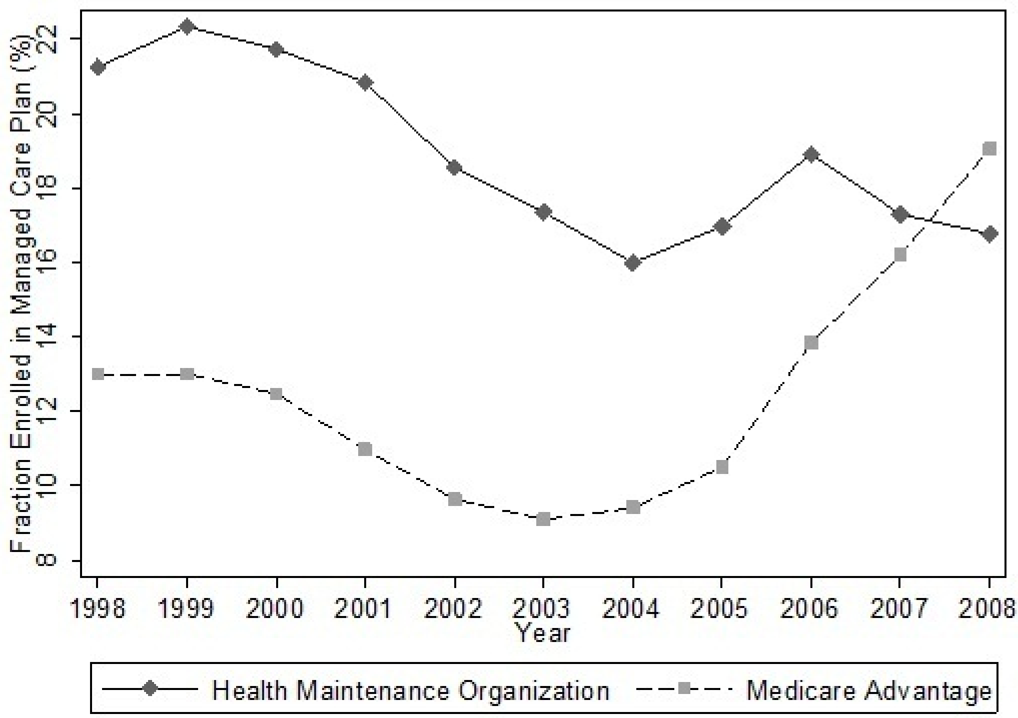

Figure 2.1 : Trend in Managed Care Penetration

Table 2.1 : Summary Statistics: Trends in Hospital Costs and HMO Activity

	A. Hospital Costs						*B. HMO Activity*	
	Total		*Unit Cost by Hospital Service*				*HMO*	
Year	*Costs*		*Inpatient*		*Outpatient*		*Penetration*	
1998	$90.2	-	$7198.4	-	$308.6	-	21.3%	-
1999	$93.4	3.6%	$7284.4	1.2%	$309.1	0.2%	22.3%	1.0%
2000	$94.9	1.6%	$7306.5	0.3%	$303.5	-1.8%	21.7%	-0.6%
2001	$98.0	3.3%	$7485.5	2.5%	$318.1	4.8%	20.9%	-0.8%
2002	$98.7	0.8%	$7924.8	5.9%	$330.7	4.0%	18.6%	-2.3%
2003	$93.3	0.6%	$8218.7	3.7%	$347.2	5.0%	17.4%	-1.2%
2004	$98.8	-0.5%	$8516.4	3.6%	$366.2	5.5%	16.0%	-1.4%
2005	$94.2	-4.6%	$8860.1	4.0%	$383.8	4.8%	17.0%	1.0%
2006	$96.3	2.2%	$8977.7	1.3%	$400.1	4.3%	18.9%	1.9%
2007	$99.2	3.1%	$9012.0	0.4%	$426.2	6.5%	17.3%	-1.6%
2008	$97.2	-2.0%	$9069.9	0.6%	$420.3	-1.4%	16.8%	-0.5%
Total		7.8%		26.0%		36.2%		-5.0%

Sample means and growth rates are reported. All costs were adjusted to reflect 2008 dollars using the U.S. Bureau of Labor Statistics CPI.

Table 2.2 : Summary Statistics: Independent and Instrumental Variables

Variable	*Mean*	*Standard Deviation*	*Source*
Independent Variables			
Hospital Herfendahl-Hirshman index	49.9	(37.3)	AHA
Medicare case mix index	1.3	(0.3)	CMS
Total inpatient discharges (#, in 1000s)	6.5	(7.3)	AHA
Total outpatient visits (#, in 1000s)	93.5	(116.5)	AHA
Wage index	1.0	(0.2)	CMS
Hospital beds (#, number)	140.3	(133.1)	AHA
Medicare discharges (%)	44.0	(18.8)	CMS
Medicaid discharges (%)	14.2	(11.8)	CMS
For-profit ownership (%)	21.0	(40.8)	AHA
Government Ownership (%)	22.3	(41.6)	AHA
Real per capita Income ($, in 1000s)	26.4	(10.1)	ARF
Instrumental Variables			
Freedom of choice (#, laws)	0.5	(0.6)	NCSL
Any willing provider (#, laws)	0.6	(0.8)	NCSL
Firms with $\geq$ 20 employees (%)	12.8	(3.4)	CBP
County unemployment rate (%)	5.2	(2.1)	ARF

Sources: American Hospital Association (AHA); Centers for Medicare and Medicaid Studies (CMS); National Conference of State Legislatures (NCSL); Area Resource File (ARF); County Business Patterns (CBP).

Table 2.3 : Estimated Effect of HMO Penetration on Log Hospital Costs

	A. Fixed Effects Results			*B. Instrumental Variable Results*		
	Total	*Unit Costs by Hospital Service*		*Total*	*Unit Costs by Hospital Service*	
	Costs	*Inpatient*	*Outpatient*	*Costs*	*Inpatient*	*Outpatient*
HMO Penetration (1998-2003)	-0.003*	-0.004***	-0.019***	-0.011***	0.020*	-0.081***
	(0.002)	(0.002)	(0.004)	(0.012)	(0.012)	(0.027)
HMO Penetration (2004-2008)[a]	0.006***	0.013***	-0.005	0.019*	0.080**	-0.055
	(0.002)	(0.002)	(0.004)	(0.017)	(0.017)	(0.045)
R^2	0.69	0.40	0.54	0.69	0.32	0.53
Number of Observations	32717	33240	32747	32400	32927	32426
Number of Hospitals	3587	3594	3577	3411	3422	3402
First Stage R^2				0.14	0.14	0.14
First Stage F-Statistic				65.84***	67.82***	67.17***
Durbin-Wu-Hausman Statistic				4.23	15.54***	7.25***
Kleibergen-Paap LM Statistic				123.01***	127.14***	117.27***
Kleibergen-Paap Wald Statistic				54.94**	57.51**	49.00**
Hanson J Statistic				0.02	4.05	4.41

Robust standard errors in parenthesis. All regressions include hospital controls, county controls, and time trends unless otherwise stated. * significant at the 10% confidence level; ** significant at the 5% confidence level; *** significant at the 1% confidence level. [a] The linear combination of β_1 and β_2 are reported.

Table 2.4 : Robustness Checks

	A. Multiple Penetration Measures			*B. Hospital Present $t = 11$ years*		
	Total	*Unit Costs by Hospital Service*		*Total*	*Unit Costs by Hospital Service*	
	Costs	*Inpatient*	*Outpatient*	*Costs*	*Inpatient*	*Outpatient*
HMO Penetration (1998-2003)	-0.006***	-0.003	-0.024***	-0.014	0.019	-0.091***
	(0.002)	(0.002)	(0.004)	(0.012)	(0.013)	(0.027)
HMO Penetration (2004-2008)[a]	0.006***	0.009***	-0.007*	0.017	0.078***	-0.068
	(0.002)	(0.002)	(0.004)	(0.018)	(0.018)	(0.046)
MA Penetration (1998-2003)	0.011***	-0.022***	-0.021***			
	(0.004)	(0.003)	(0.007)			
MA Penetration (2004-2008)	0.006*	0.035***	0.024***			
	(0.004)	(0.003)	(0.007)			
R^2	0.63	0.39	0.43	0.70	0.33	0.53
Number of Observations	32576	33093	32614	29767	30245	29821
Number of Hospitals	3586	3594	3577	2876	2886	2876
First Stage R^2				0.14	0.14	0.14
First Stage F-Statistic				66.16***	67.27***	72.39***
Durbin-Wu-Hausman Statistic				4.467	14.463***	9.39***
Kleibergen-Paap LM Statistic				118.94***	122.94***	112.54***
Kleibergen-Paap Wald Statistic				53.26**	56.16**	47.23**
Hanson J Statistic				0.002	3.85	5.14*

Robust standard errors in parenthesis. All regressions include hospital controls, county controls, and time trends unless otherwise stated. * significant at the 10% confidence level; ** significant at the 5% confidence level; *** significant at the 1% confidence level. [a] The linear combination of β_1 and β_2 are reported.

Table B.1 : Estimated Effect of HMO Penetration on Log Managed Care Plans

	HMO Plans	*PPO Plans*
Freedom of choice (#, laws)	-0.097*	0.195***
	(0.059)	(0.038)
Any willing provider (#, laws)	-0.083**	-0.032
	(0.038)	(0.00)
County unemployment rate (%)	-0.023**	-0.011
	(0.012)	(0.008)
Firms with $\geq$ 20 employees (%)	0.10***	0.109***
	(0.009)	(0.006)
R^2	0.14	0.20
Number of Observations	45244	50522
Number of Counties	1990	2370

The dependent variable is HMO Penetration. Robust standard errors in parentheses. Regressions include time trends. * significant at the 10% confidence level; ** significant at the 5% confidence level; *** significant at the 1% confidence level.

Table B.2 : First Stage Results

	Total Costs	*Unit Costs by Hospital Service*	
		Inpatient	*Outpatient*
Freedom of choice (#, laws)	3.845***	3.833***	4.168***
	(0.519)	(0.535)	(0.518)
Any willing provider (#, laws)	-1.976***	-1.968***	-1.879***
	(0.438)	(0.436)	(0.437)
County unemployment rate (%)	-0.696***	-0.707***	-0.726***
	(0.053)	(0.053)	(0.054)
Firms with $\geq$ 20 employees (%)	1.752***	1.764***	1.663***
	(0.565)	(0.572)	(0.557)
R^2	0.14	0.14	0.14
Number of Observations	32400	32927	32426
Number of Hospitals	3411	3424	3402
F-test of excluded instruments	65.84***	67.82***	67.17***

There are different first stage estimates for each cost regression since the sample size varies by the cost measure used. Robust standard errors in parentheses. All regressions include hospital controls, county controls, and time trends. * significant at the 10% confidence level; ** significant at the 5% confidence level; *** significant at the 1% confidence level.

Table B.3 : Unit Root Tests

	Total Costs	*Unit Costs by Hospital Service*	
		Inpatient	*Outpatient*
Levin-Lin-Chu Statistic	-26.250***	-81.817***	-118.610***
Number of Panels	2438	2438	2438
Number of Periods	11	11	11
Observations	24380	24380	24380

Each test includes a constant term to capture hospital fixed effects.
* significant at the 10% confidence level; ** significant at the 5% confidence level; *** significant at the 1% confidence level.