THE EFFECTS OF ENDOGENOUS MARKET ENTRY OF PHYSICIAN-OWNED HOSPITALS ON MEDICARE EXPENDITURES: AN INSTRUMENTAL VARIABLES APPROACH

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This study examines the effect of physician-owned hospitals (POHs) on Medicare per enrollee expenditures at the metropolitan area (MSA) level nationwide, spanning the 8-year time period from 1998 to 2005. The study uses fixed effects panel data estimation with instrumental variables to account for the bias introduced by endogenous POH market entry (i.e., POHs may be more likely to open in high-growth/high-demand markets with high levels of Medicare per enrollee expenditures). After controlling for other variables that are likely to affect expenditures (especially the age and sex distribution of the MSA), we find no association between POH presence and Medicare expenditures per enrollee at the MSA level. The results are robust to changes in model specification, estimation technique, and definition of geographic market. These findings suggest that the "demand inducement" aspects of physician ownership of acute care hospitals (if any) have no meaningful impact on market-level Medicare expenditures per enrollee. Current policies based on an assumption that POHs are associated with significant increases in total expenditures may need to be reassessed. (*JEL* I11, L10, C33)

I. INTRODUCTION

Physician-owned hospitals (POHs) continue to spark lively business and political debates. Those opposed to POHs (many of which are limited-service specialty hospitals) argue that a significant financial conflict of interest is inherent in physician ownership of POHs, creating strong incentives for induced demand and unnecessary services, which in turn increase market-level utilization and expenditures. Opponents of limited-service facilities believe that these hospitals create an uneven playing field by specializing in profitable services without having to use these profits to cross-subsidize unprofitable services offered by "full service" general hospitals (Choudhry, Choudhry, and Brennan 2005; Iglehart 2005; Kahn 2006; Shactman 2005). In contrast, those not opposed to POHs argue that, to varying degrees, these hospitals offer greater economic efficiency, higher quality, more consumer-responsive products and services, and provide beneficial competition to general hospitals (Cain Brothers & Company LLC 2003; Casey 2004; Chollet et al. 2006; Dobson and Haught 2005; Domrzalski 2002; FTC 2004; Herzlinger 2002; Schneider et al. 2007; Walker 1998).

In 2008, the Congressional Budget Office (CBO) estimated that if physician ownership of specialty hospitals were substantially limited,

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ABBREVIATIONS

CBO: Congressional Budget Office
CMS: Centers for Medicare and Medicaid Services
CON: Certificate of Need
HRRs: Hospital Referral Regions
IV: Instrumental Variables
MedPAC: Medicare Payment Advisory Commission
MSA: Metropolitan Area
POHs: Physician-Owned Hospitals

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the potential savings to the Medicare program would be roughly \$1.8 billion over the 2008–2017 period (CBO 2008). These estimates were based on an assumption that physician ownership interests in hospitals would result in increases in utilization of 15% above normal expected growth (CBO 2007). These estimates, according to the CBO, were based on an informal review of the literature on the relationship between physician asset ownership (mainly in outpatient or ancillary services) and utilization.

It is not clear, however, whether the extant literature on physician asset ownership and utilization can be invoked in the case of physician ownership of acute care short-stay hospitals, as the CBO has implied in its calculations. First, most existing studies do not address the potential endogeneity of physician ownership; estimates of the causal impact of physician ownership on expenditures treating ownership as exogenous are likely to be biased upward. Second, most existing studies of physician ownership interests apply to facilities in which physicians have a significant ownership share (e.g., imaging facilities), but physician ownership shares in POHs tend to be small, with the vast majority of physicians with ownership shares less than 5% (Chollet et al. 2006; CMS 2005; GAO 2003a; Schneider et al. 2008). Finally, it is not clear whether traditional notions of physician-induced demand continue to be relevant in an era of aggressive care management and improved transparency.

In this paper we employ a relatively straightforward analysis of the effect of POHs on trends in Medicare per enrollee expenditures at the metropolitan area (MSA) level. If the presence of POHs is associated with higher Medicare expenditures, ceteris paribus, then the extant consensus on the general effects of physician asset ownership may apply to POHs. Conversely, if there are no detectable effects of POHs on Medicare expenditures, we may reasonably assume that generally small physician ownership shares in acute short-stay hospitals do not confer incentives for utilization of the same magnitude as often associated with ownership of, for example, diagnostic equipment. One of the limitations of recent published studies on this topic is that POH entry is highly likely to be endogenous with Medicare expenditures; areas of rapid growth in utilization are good places to start new health care ventures. Thus, results of regression analyses are likely to be biased. We address this problem by employing an instrumental variable technique to account for endogenous POH entry.

The paper is organized as follows. Section II reviews the literature to date on the effects of POHs and specialty hospitals on utilization and expenditures. Section III describes the methods and data. The data analysis employs an 8-year (1998–2005) panel data design to examine the effects of POHs and other covariates on Medicare expenditures per enrollee at the MSA level. The analyses assume area-level fixed effects, which takes into account unobservable characteristics that do not vary over time. Section IV reports the results of descriptive and econometric analyses. Section V discusses the results and policy implications. Section VI offers some concluding remarks.

II. BACKGROUND

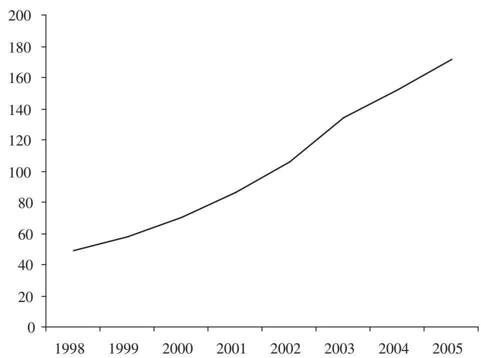
A. Overview

The term "specialty hospital" is typically used to refer to hospitals that treat patients with specific medical conditions or those in need of specific medical or surgical procedures.[1] The "specific medical condition" part of the definition describes hospitals specializing in psychiatric care, rehabilitation, cancer care, long-term care (excluding nursing homes and skilled nursing facilities), women's care, children's care, and other hospitals focused on certain chronic diseases. These hospitals have been in existence for a long time, and may be viewed as "traditional" specialty hospitals. The "specific medical or surgical procedure" part of the definition describes hospitals specializing in cardiac, orthopedic, and general surgery. The majority of these hospitals are new. Compared to traditional specialty hospitals, the new wave of specialty hospitals are considerably more likely to be owned by physicians. Approximately 70% of surgical hospitals have at least some level of physician ownership (GAO 2003a).

Recent political controversies surrounding specialty hospitals have focused primarily on facilities owned by physicians, primarily as a result of concerns that the incentives associated with ownership will encourage physicians to induce demand for their services, thereby increasing medical care costs (GAO 2003a,

1. For example, the General Accounting Office has defined specialty hospitals as those that "tend to focus on patients with specific medical conditions or who need surgical procedures" (GAO 2003c).

FIGURE 1
Number of POHs by Year, 1998–2005



Source: PHA (2008).

2003b, 2006; MedPAC 2005, 2006). Growth in the number of POHs has more than tripled since 1998 (Figure 1). According to recent data from the specialty hospital trade association, there were approximately 170 POHs in operation in the United States as of December 31, 2005 (PHA 2008). While the vast majority of POHs are specialty hospitals (mostly surgical), there are a small number of physician-owned general hospitals.

Numerous studies of specialty hospitals and POHs have recently been conducted. In short, these hospitals appear to provide quality at least as good (and often better) than their general hospital counterparts, treat a somewhat healthier patient mix, do not appear to financially harm nearby general hospitals, and appear to result in somewhat higher raw utilization rates at the area level (Barro, Huckman, and Kessler 2006; CMS 2005; Cram, Rosenthal, and Vaughan-Sarrazin 2005; Cram et al. 2007; GAO 2006; Mitchell 2005, 2007; Nallamothu et al. 2007a; Schneider et al. 2007). The findings on the effects of specialty hospitals and POHs on utilization and expenditures, however, have been somewhat conflicting—in large part because of differing methodologies.

B. Effect on Expenditures

Several studies to date have explored the ownership-utilization association. The first of these studies was conducted by Research Triangle International under contract to the Centers for Medicare and Medicaid Services (CMS). The CMS study is especially noteworthy because they were able to measure actual physician ownership shares through site visits to 13 specialty hospitals, and link those ownership shares to Medicare claims data through the Medicare provider identifier; no other study has done this. The CMS study found that the incentive for physicians to refer to hospitals in which they have an ownership stake depended more on the size of the ownership stake rather than the fact that they were owners (Greenwald et al. 2006). Given that ownership shares on average were very low, the CMS study found that referral patterns were not significantly affected by the entry of specialty POHs into the market. The most important limitation of the CMS study is that it did not take into account endogenous POH entry and did not examine the role of baseline trends in utilization. However, using a different methodology, the CMS study essentially reached the same conclusions as a parallel study conducted by the Medicare Payment Advisory Commission (MedPAC) (Stensland and Winter 2006). The MedPAC study used a "differences in differences" model to examine the effect of cardiac specialty hospitals on changes in Medicare cardiac treatment costs from 1996 to 2002. The study found no statistically significant findings in utilization rates between hospital referral regions (HRRs) with and without cardiac specialty hospitals.

Barro, Huckman, and Kessler (2006) analyzed Medicare claims data from 1993, 1996, and 1999, using a matched case control panel design with fixed HRR effects. Their main findings were that hospital expenditures for patients treated in HRRs with cardiac specialty hospital entry ("entry HRRs") experienced roughly 3% slower growth in cardiac care expenditures compared to patients treated in HRRs without cardiac specialty hospitals ("control HRRs"). Under the reasonable assumption that entry HRRs would have retained their 1993–1996 trend in expenditures and outcomes in the absence of entry, they found that specialty hospital entry leads to both a *reduction* in expenditures of at least 7% and a reduction in mortality of at least 4%. The results were robust to several different specification tests. The main limitations of the Barro et al. study is the limited time frame (using only three time points with 1999 as the most recent year) and the implied assumption of exogenous market entry.

A study by Nallamothu et al. (2007a, 2007b) also examined the effects of cardiac specialty hospitals, but reached somewhat different conclusions. Using Medicare claims data from

1995 to 2003, they find that rates of change for total revascularization were higher in HRRs after cardiac hospitals opened when compared with HRRs where new cardiac programs opened at general hospitals and HRRs with no new programs. Four years after their opening, the relative increase in adjusted rates was more than twofold higher in HRRs where cardiac hospitals opened when compared with HRRs where new cardiac programs opened at general hospitals and HRRs with no new programs. The study has three important limitations. First, it does not adequately control for the likelihood that specialty hospitals are more likely to enter areas with higher than average pre-entry levels of utilization and expenditure. Second, putting aside the problem of endogenous entry, their results are only generalizable to specialty cardiac hospitals, of which there are approximately 30 nationwide. Third, it is not clear how much variation in HRR utilization rates is explained by the models and how well the models deal with unobservable time-variant HRR characteristics.

Two studies by Jean Mitchell reach conclusions somewhat similar to those of Nallamothu et al. (2007a, 2007b), although the methods differ substantially. One of these studies analyzed workers' compensation claims in Oklahoma, finding that the entry of orthopedic specialty hospitals was followed by substantial increases in market area utilization for complex fusion surgery (Mitchell 2007). The study is only descriptive and thus substantially limited by its lack of statistical controls; for example, differences in case mix, baseline trends, and endogenous entry are not addressed. An earlier study by Mitchell (2005) reached similar conclusions using state-level data from Arizona, although the study is to a great extent hampered by its assumption that physician owners can be identified simply as physicians with high-volume POH admissions.

The net result of these studies is mixed. The studies employing higher levels of methodological rigor (Barro, Huckman, and Kessler 2006; Nallamothu et al. 2007a, 2007b) reached different conclusions. The CMS and MedPAC studies reach conclusions in line with those of Barro et al., and the Mitchell studies reach conclusions more in line with Nallamothu et al. (2007a). On balance, it seems reasonable to conclude that part of the lack of convergence in the literature is because of some combination of failure to account for endogenous entry, baseline trends in utilization at the area level, and unobservable market area effects. The present study addresses each of these influences.

III. METHODS

The basic approach of this analysis is similar to that of Nallamothu et al. (2007a, 2007b) and Barro, Huckman, and Kessler (2006) and is driven by the following hypothesis: if ownership of acute care hospitals encourages physician owners to provide more services than their nonowner counterparts, then medical care expenditures in areas with POHs should be higher, ceteris paribus, than areas without POHs.

Our approach differs from earlier studies in four important ways. First, we examine a long 8-year time period—1998 through 2005. Nallamothu et al. (2007a, 2007b) examined a 9-year period, but their analysis extended only through 2003. Approximately 40 POHs were added in 2004 and 2005. The additional 2-years of data also allow greater time for established specialty hospitals to have an effect, and additional opportunity to examine the effects of new entrants. Second, we use a two-stage least squares model with instrumental variables (IV) in order to account for the likely endogeneity of POH entry. The combination of IV and area-level fixed effects over the 8-year period provides an effective control for endogenous entry. No previous study used sufficient controls for endogenous entry. Third, rather than using HRRs, as did Nallamothu et al. (2007a, 2007b) and Barro, Huckman, and Kessler (2006), we use MSAs as the relevant geographic market. In part, our focus on MSAs relates to the fact that candidates for IVs used in the analysis are measured at the county level, which may be readily aggregated to the MSA level, but not to the HRR level (HRRs are defined in terms of patient zip codes). Hospital markets have been shown to be highly correlated with MSAs (Sohn 2002), but as a sensitivity test, we replicate our regression models using approximate HRRs defined by county as the market area. Finally, unlike previous studies which were limited to cardiac surgery hospitals (and expenditures for cardiac treatment), we cast a wider net, including all POHs in a market area.[2]

2. POH is defined to include general hospitals, surgical hospitals, and women's hospitals with at least some physician ownership. This definition may include "traditional" specialty hospitals, such as those specializing in psychiatric, rehabilitative, or children's care, although such hospitals are typically not physician-owned.

The study design is a panel data model, with observations defined as MSA-years and with dummy variables indicating the presence of at least one POH in the area. The equation to be estimated has the following form (Equation [1]):

$$(1)\ \mathrm{E}_{it} = \alpha_0 + \alpha_1\hat{\mathrm{S}}_{it} + \alpha_2\mathrm{R}_{it} + \sum \alpha_n\mathbf{H}_{it} + \sum \alpha_n\mathbf{SE}_{it} + \sum \alpha_n\mathbf{T}_t + \varepsilon_{it}$$

where E_{it} refers to total part A and part B Medicare fee-for-service expenditures per enrollee in MSA i and time period t. The term $\hat{\mathrm{S}}_{it}$ is a dummy variable equal to one if there is one or more POH in the area. The model is risk-adjusted through the inclusion of the R_{it} term, which is a risk-adjustment measure calculated by CMS based on county-level distribution of Medicare enrollees by age, sex, institutional status, and Medicaid (dual eligible) status (CMS 2007).

The vector $\mathbf{H}_{it}$ refers to supply-side health care measures, including the number of physicians per population, the number of surgeons per population, the number of beds per population, a measure of concentration of the acute care hospital market,[3] and a measure of Medicare managed care penetration. The vector $\mathbf{SE}_{it}$ denotes area-level socioeconomic characteristics, including education, unemployment, and poverty status. These can be considered demand-side variables. Finally, the vector $\mathbf{T}_t$ represents dummy variables for each year (1998 is the reference year).

To address endogenous entry, we identified instruments for the presence of specialty hospitals ($\hat{\mathrm{S}}_{it}$). The challenge of IV models is to identify instruments that explain variation in the endogenous variable ($\hat{\mathrm{S}}_{it}$) but are not highly correlated with the dependent variable (E_{it}). After testing several candidates, we determined that population density and per capita income displayed reasonably good IV properties.[4] Hence, the first-stage model can be expressed as (Equation [2]):

$$(2)\ \hat{\mathrm{S}}_{it} = \delta_0 + \delta_1\mathrm{D}_{it} + \delta_2\mathrm{Y}_{it} + \sum \delta_n\mathbf{X}_{it} + \varepsilon_{it}$$

In the first-stage model, population density (D_{it}) serves as a measure of potential market share; densely populated areas have the potential for greater market share for physician entrepreneurs. In addition, per capita income (Y_{it}) is a proxy for the ability of the market to pay for services. It may also serve as a proxy for demand for the kinds of amenities typically offered by physician-owned specialty hospitals (e.g., Casey 2004). The vector $\mathbf{X}_{it}$ includes the covariates from Equation (1) (excluding $\hat{\mathrm{S}}_{it}$).

The estimations of Equations (1) and (2) are specified as longitudinal panel data regressions with fixed area effects (Baltagi 1995; Hsiao 1986). One of the advantages of this approach is that it allows for the effects of specialty hospital entry to accrue over time, effects that may not be observable looking only at a cross-sectional snapshot. The other advantage of the 8-year fixed effects panel design is that the potential endogeneity of specialty hospital entry is reduced, and is further reduced by the IV method. Fixed effects models assume that unobserved heterogeneity is essentially a parameter to be estimated, typically by dummy variables for all i observations (Wooldridge 2002). Compared with random effects, the fixed effects estimator is more robust and better suited to datasets that reflect the population of interest (i.e., MSAs). All continuous variables are expressed in natural logs, and the regression coefficients of categorical variables are adjusted for the logging (Kennedy 1981).

Several studies have noted that state "Certificate of Need" (CON) regulation serves as a significant barrier to entry by POHs (Choudhry, Choudhry, and Brennan 2005; Havighurst 2005). However, because there was no change in state CON status over the sample period, the fixed effects models do not permit any adjustment for the impact of CON because it becomes one of many time-invariant state-level variables subsumed into the hospital/state fixed effect.

The analytic file used to estimate Equations (1) and (2) consists of the merger of several

3. Hospital concentration is measured using county and MSA-level calculations of a Herfindahl-Hirschman Index (HHI). The HHI is calculated by summing the squares of each hospital's market share in the county; that is, $\mathrm{HHI} = \sum 100^* s_i^2$, where s denotes the market share of hospital i. This method allows for hospitals with relatively large market share (e.g., 60%) to be more heavily weighted in the index.

4. The demand variables included in the first-stage model (population density and per capita income) differ from the demand variables included in the second-stage (unemployment rate and poverty rate). We submit that the second-stage demand variables are measuring the access component of demand, which is more likely to directly impact expenditures, whereas the first-stage demand variables are more likely to reflect operating margins (and thus, the attractiveness of entry).

county-level data sources. County-level Medicare fee-for-service expenditure data (part A and part B) were obtained directly from CMS. Expenditures attributable to direct and indirect medical education and disproportionate share payments are subtracted from the total per capita amounts (CMS 2007). All dollar amounts are expressed as 2005 dollars using the all-items Consumer Price Index. Data for other variables were obtained from the Bureau of Health Professions Area Resource File (2003, 2005, and 2007 releases). Data on specialty hospital presence was obtained from Schneider et al. (2007) and cross-referenced with 2008 membership data maintained by the POH trade association, Physician Hospitals of America. The calculations of HHI by MSA were based on short-stay acute care hospital admission data from Medicare Cost Reports for each year.[5]

IV. RESULTS

Descriptive means, standard deviations, and trends are shown in Table 1. All data are based on an MSA unit of observation ($n = 938$). To enhance readability, descriptive tables show data only for 1998 and 2005; there were no unusual temporal anomalies in the years not shown. Adjusted for inflation, total Medicare expenditures per capita grew 25% over the 8-year period. In 1998, only 2% of MSAs had at least one POH, compared to 5% in 2005. Most of the growth in POHs over the time period occurred in markets with more than one POH.[6] Changes in other variables were small, with the exception of acute care beds per 1,000 population, which fell by more than 10% over the time period, consistent with the general trend toward downsizing and increased capacity utilization in the acute care sector (American Hospital Association 2004).

There were some interesting descriptive differences between markets with and without POHs (Table 2). Markets with POHs had significantly higher Medicare expenditures per enrollee, but somewhat slower expenditure growth over the time period (Table 2 and Figure 2). Markets with POHs had significantly higher expenditures per enrollee (5.2%) at the beginning of the time period, but the raw difference narrowed considerably by 2003 (although the difference remains statistically significant). Markets with POHs also had higher per capita income and were more densely populated.[7] They also had faster rates of growth in these three measures, especially growth in surgeons per 10,000 population.

The regression model results are shown in Table 3. Models 1 and 2 report the specifications with MSA-level fixed effects. The fit of the MSA models is reasonably good (R-squared $= 0.80$). The largest coefficients are associated with the risk score and the time dummy variables, all of which are significant. Model 1 assumes exogenous physician-hospital entry, and is specified as a single-stage fixed effects model. The POH indicator is negative (-1.2%) but fails to reach statistical significance ($p = .12$). Model 2 is the two-stage model with instrumental variables, where per capita income and population density are instruments for the presence of POHs. The first-stage F statistic of excluded instruments is 18.02 ($p = .00$) and the first-stage Sargan over-identification test is 2.31 ($p = .13$) (Cragg and Donald 1993; Wooldridge 2002). Both tests suggest that our chosen instruments work reasonably well in the model. The coefficient on the POH indicator variable is negative and not statistically significant ($p = .403$).

Several alternative specifications were tested. The first variation was to create different POH indicator variables to differentiate between "new" entrants (opened within 2 years prior to the index year) versus "established" entrants (opened more than 2 years prior to the index year). When used in the same models reported above, the established POH indicator behaved exactly the same as the "any POH" indicator. When the new POH indicator was used, we could not identify instruments that would result in reasonable IV diagnostic tests. Variables for number of POHs in the area or total POH beds in the area were used as alternative measures of the presence of POHs. Results from models using these continuous POH measures were qualitatively similar to results using

5. See generally http://www.cms.hhs.gov/CostReports

6. In 1998, of the 19 MSAs with POHs, 7 MSAs had more than one POH (37%). In contrast, in 2005, of the 47 MSAs with at least one POH, 26 MSAs had more than one POH (55%). This type of growth is explained mainly by the fact that POHs can only grow in states without CON, which for the most part already had POHs present by 1998. Moreover, following normal entry incentives, POHs tend to locate in markets with above-average population growth, there again limiting growth options to a relatively circumscribed set of geographic alternatives.

7. Differences in surgeons per 10,000 population were not statistically significant.

TABLE 1
Means, Standard Deviations,[a] and Trends in Variables, 1998 and 2005

Variable[b]	*n*	1998	2005	Percent Change
Medicare expenditures per enrollee[c]	938	\$5,300.54 (\$989.55)	\$6,618.75 (\$967.36)	24.87
POH in area	938	0.02 (0.14)	0.05 (0.21)	150.00
CMS composite risk score	938	0.98 (0.04)	0.98 (0.05)	0.52
Physicians/10k population	938	15.45 (9.54)	16.59 (10.42)	7.39
Surgeons/10k population	938	3.59 (1.81)	3.95 (2.48)	9.90
Beds/1k population	938	3.46 (1.84)	3.10 (1.70)	−10.39
Acute care hospital HHI	938	7129.38 (2762.36)	7484.82 (2650.40)	4.99
% Medicare managed care	938	5.20 (9.58)	5.38 (9.13)	3.35
% 25+ with ≤9 years education	938	8.79 (4.80)	8.83 (5.04)	0.48
% 25+ with ≥high school	938	77.44 (8.40)	77.55 (8.45)	0.14
% 25+ with ≥4 years college	938	16.71 (7.46)	16.86 (7.60)	0.93
% Unemployed	938	5.06 (2.53)	5.46 (1.72)	7.90
% Below poverty	938	14.06 (5.21)	13.84 (4.45)	−1.53
Per capita income[c]	938	\$26,802.42 (\$4,950.16)	\$27,990.69 (\$5,395.33)	4.43
Population per square mile	938	189.13 (475.09)	201.03 (502.92)	6.29

[a]Standard deviations are in brackets.
[b]Unit of analysis is the MSA.
[c]Medicare expenditures per enrollee and per capita income are in 2005 dollars.

the simple dichotomous measure. Other model variations included the substitution of related covariates (percent white collar in place of the education attainment variables) and the substitution of related instruments (e.g., percent below poverty and mean household income in place of per capita income). Swapping related covariates had small effects on overall model performance and no effect on the POH coefficient and level of significance. Swapping related IVs resulted in model instability and poor IV diagnostic tests, although mean household income worked almost as well as per capita income in the IV models.

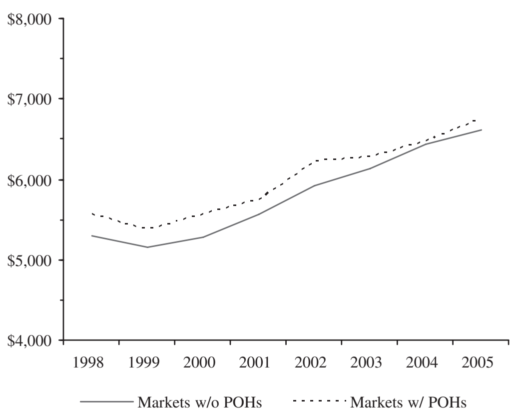
Finally, we also estimated models with the county and the HRR as the geographic market. Counties are typically smaller than MSAs and HRRs are typically larger than MSAs. However, in both cases the IV models had relatively poor fit, failing the over-identification and under-identification tests, even after testing variations in specification of first- and second-stage models. A likely explanation for the poor performance of the county-level IV models is that the county is, on average, too small a geographic unit for acute care hospital markets. A likely explanation of the HRR findings is the reliance on aggregates of county-level IV measures, especially given the error introduced by a forced one-to-one matching of counties to HRRs to generate HRR-level IV measures. Specifically, the vast majority of area-level data for IVs is available only at the county level (e.g., from Area Resource File), but only 11% of U.S. counties lie completely within a single HRR (which are based on aggregates of zip codes). To

TABLE 2
Means, Standard Deviations,[a] and Trends in Key Variables

Variable[b]		1998	2005	Percent Change
			Markets without POHs	
Medicare expenditures per enrollee[c]		$5,295.21	$6,611.70	24.86
		($985.96)	($957.71)	
Surgeons/10k population		3.58	3.89	8.84
		(1.82)	(2.49)	
Per capita income[c]		$26788.63	$27906.49	4.17
		($4969.12)	($5412.29)	
Population per square mile		186.88	194.92	4.30
		(474.39)	(505.25)	
			Markets with POHs	
Medicare expenditures per enrollee[c]		$5,572.55	$6,758.66	21.28
		($1,157.64)	($1,145.62)	
	Difference	+$277.34**	+$146.96**	
Surgeons/10k population		4.39	5.04	14.79
		(1.25)	(1.92)	
	Difference	+0.81	+1.15	
Per capita income[c]		$27,507.30	$29,661.69	7.83
		($3,903.93)	($4,801.57)	
	Difference	+$718.67**	+$1,755.20**	
Population per square mile		304.10	322.26	5.97
		(510.48)	(441.87)	
	Difference	+117.22**	+127.34**	

Notes: Comparisons of MSAs with and without physician-owned hospitals, 1998 and 2005, difference = column difference and statistical significance of that difference.
[a]Standard deviations are in brackets.
[b]Unit of analysis is the MSA.
[c]Medicare expenditures per enrollee and per capita income are in 2005 dollars.
**Column difference is statistically significant at $p \leq .05$.

FIGURE 2
Trends in Total Medicare Expenditures per Enrollee by Market Physician Hospital Status, 1998–2005



Source: PHA (2008) and CMS (2008).

create a forced one-to-one mapping of counties to HRRs, we used geographic information software (GIS) to map zip code centroids to counties, ignoring the distribution of the population within the zip code and the physical boundaries of the zip code. For counties containing zip code centroids in more than one HRR, we assigned the county to the HRR containing zip codes representing the plurality of county-level population. Whereas the IV models performed poorly, the non-IV HRR analysis found that the presence of POHs is associated with a reduction in Medicare expenditures of 3%, which falls within the 3%–7% range in POH-attributable expenditure reductions found by Barro, Huckman, and Kessler (2006).

V. DISCUSSION

After taking into account the endogeneity of POH market entry, we find no evidence that such entry leads to higher Medicare expenditures per enrollee. These results are

TABLE 3
Results of MSA-Level Fixed Effects Models on Total Medicare Expenditures per Enrollee

Variable[a]	**(1)**[b]	***p***	**(2)**[c]	***p***
POH in area	−0.01151	.118	−0.07840	.433
CMS composite risk score	0.32941	.000**	0.33686	.000**
Physicians/10k population	−0.00532	.001**	−0.00529	.001**
Surgeons/10k population	0.00103	.039**	0.00104	.038**
Beds/1k population	0.00201	.010**	0.00198	.012**
Acute care hospital HHI	0.00149	.309	0.00142	.335
% Medicare managed care	0.00014	.285	0.00013	.315
% 25+ with $\leq$ 9 years education	0.00738	.078*	0.00600	.200
% 25+ with $\geq$ high school	0.06378	.004**	0.06250	.005**
% 25+ with $\geq$ 4 years college	−0.00307	.408	−0.00399	.316
% Unemployed	0.03543	.000**	0.03495	.000**
% Below poverty	−0.00661	.536	−0.00533	.625
Year = 1999	−0.02282	.000**	−0.02281	.000**
Year = 2000	0.00229	.362	0.00276	.293
Year = 2001	0.05413	.000**	0.05528	.000**
Year = 2002	0.11649	.000**	0.11793	.000**
Year = 2003	0.15244	.000**	0.15447	.000**
Year = 2004	0.20449	.000**	0.20653	.000**
Year = 2005	0.22248	.000**	0.22444	.000**
Intercept	8.24492	.000**	8.25519	.000**
Number of observations	7,504		7,504	
Number of groups	938		938	
R-squared	0.80		0.80	
Overall *F*	1364.27	.000**	1347.20	.000**
First stage *F*			18.02	.000**

[a]With the exception of the dummy variables, all variables are expressed in logs.
[b]Model 1 is MSA-level fixed effects assuming exogenous specialty hospital entry.
[c]Model 2 is MSA-level fixed effects assuming endogenous specialty hospital entry, using 2SLS with population density and per capita income as instruments for the presence of any type of POH.
**Statistically significant at $p \leq .05$;
*Statistically significant at $p \leq .10$.

not entirely different from those of the studies carried out by MedPAC and Barro, Huckman, and Kessler (2006), each of which failed to find a positive relationship between POH entry and Medicare expenditures. In the descriptive analysis (Table 2), expenditures per enrollee were 5.2% higher in MSAs with POHs compared to MSAs without POHs. However, in the multivariate model adjusting for differences in MSA-level variables, with POH entry treated as exogenous (Table 3, column 1), MSAs with POHs are estimated to have expenditures per enrollee about 1% *lower* than markets without POHs, but the difference is not statistically significant ($p = .14$). Similarly, after controlling for endogenous entry in the two-stage model (Table 3, column 2), the estimated POH effect remains negative but not statistically significant ($p = .43$). Combined with the higher unadjusted mean expenditures per enrollee in POH markets reported in Table 2, this implies that endogenous entry is an important issue when trying to assess putatively causal effects of POH entry on expenditures.

There are at least two explanations for these findings. The most plausible explanation is that the small average market share of POHs mutes their impact. An alternative explanation is that we cannot observe possible "demand inducement" because there are too many confounding factors associated with the presence of POHs. POHs generally provide higher quality of care in the form of lower mortality rates (Barro, Huckman, and Kessler 2006; Cram, Rosenthal, and Vaughan-Sarrazin 2005; Cram et al. 2007) and lower rates of surgical complications (CMS 2005). Insofar as higher inpatient quality of care is associated with lower inpatient expenditures, countervailing quality effects could mask other drivers of expenditures. Another confounding factor is hospital competition. In a selective contracting environment, hospital competition for health plan contracts is based in part on efficiency and utilization. The added competition of POHs has been shown to improve the efficiency of general hospitals in the same market (Schneider et al. 2007), and competition for contracts may also have a mitigating effect on utilization rates. If we believe that these countervailing effects exist, as the literature suggests they do, expenditure increases attributable to demand inducement are small enough to be eclipsed by quality and efficiency effects, neither of which is likely to be particularly large.

This study has several limitations which suggest some caution in interpreting results. The first issue relates to the decision to combine all types of POHs into one indicator variable. The purpose of assessing the "average POH effect" was twofold: (1) the number of POHs is small, meaning that disaggregating by POH type results in very small counts and (2) due in part to small numbers, the results of two studies focused only on cardiac[8] POHs have reached conflicting conclusions (Barro, Huckman, and Kessler 2006; Nallamothu et al. 2007a). Although previous studies do not offer much guidance, it is possible that the lack of observed POH effect in the present study is because one type of hospital (e.g., cardiac, as found by Barro, Huckman, and Kessler 2006) leads to expenditure reductions, while other types of POHs may result in increasing expenditures, and the composite measure is showing a "net" effect of zero. It is possible that the alternative POH indicator variables might indirectly account for this (i.e., in markets with more than one POH, it is more likely that there exist POHs of different specialties), but model results using total number of POHs or total POH beds were quantitatively similar to those using the dichotomous POH indicator variable.

A second and somewhat related limitation is the lack of detail relating to the specific types of procedures provided by POHs in different market areas. For example, over the sample period examined in our study, patterns of cardiac revascularization procedures continued to shift away from coronary artery bypass graft (CABG) to percutaneous coronary intervention (PCI) (Nallamothu et al. 2007b). Given that virtually all cardiac POHs perform both CABG and PCI, it is unclear how this trend may affect our results. Although the requirements for IV estimation preclude any attempts to address the potential impact or procedure mix on our results, the models using different measures of POH presence failed to indicate any positive association with total expenditures.

Thus, in this study we trade off precision in the measurement of specific aspects of POHs in different market to attain a pool of POHs sufficient to enable us to address the impact of endogenous entry by POHs. We believe that this is a reasonable trade off given the direction of current policy debates, which have moved away from concern over "specialty hospitals" and more toward concern over physician ownership.

These findings have some important implications for public policy. First and foremost, policy makers should use caution in assuming that limiting growth in POHs will result in savings. For example, in 2008 the CBO estimate of $1.8 billion savings from limiting physician ownership in POHs was proposed as an "offset" to achieve budget neutrality on other bills (e.g., mental health parity legislation or State Children's Health Insurance Program expansions). The results of the present study, together with the earlier findings from MedPAC (2005) and Barro, Huckman, and Kessler (2006), suggest that such limitations on physician ownership may not have any effect on Medicare expenditures, and—if the consistent findings on quality are taken into account—could actually result in lower aggregate levels of quality for Medicare beneficiaries.

The second policy implication is that the overall objectives of POHs may not necessarily be driven primarily by the financial benefits of owner self-referral. Others have reported that POHs and specialty hospitals offer physicians greater control and autonomy and more opportunity for volume-based learning (Casey 2004; CMS 2005; MedPAC 2006; Rohack 2004; Schneider et al. 2008). In addition, for the vast majority of cases, the professional fee charged by the physician will be substantially greater than the physician's share (via ownership) of the hospital facility payment, particularly in cardiac hospitals. Thus, in the case of ownership of acute care facilities, the incentives for self-referral are likely to be roughly similar across all types of hospital-physician relationships. Moreover, referral arrangements between general hospitals

8. To date, orthopedic specialty hospitals have not been studied separately.

(non-POH) and staff physicians often include economic credentialing, indirect compensation and other informal reward mechanisms, thereby blurring the incentive distinctions between POH and non-POH settings (Dube and Mills 2001; Hyatt 2001; Lewin, Crane, and Clements 2001; Lynk and Spang 2007; Nolan 2000; Reynolds and Goodroe 2005; Dubinsky et al. 2008).

VI. CONCLUSIONS

Each of our models failed to find a positive association between POH presence and higher Medicare expenditures per capita. Instead, models assuming exogenous entry offer weak evidence of a negative association between POH presence and Medicare expenditures. However, the most robust finding is that under the plausible assumptions of endogenous entry and MSA geographic markets, there is no effect of POHs on Medicare expenditures per capita. These results should be evaluated in parallel with previous studies of POH effects on expenditures. If the belief that POHs are expenditure-increasing is incorrect, as we suggest it might be, then (other things equal) restricting entry of POHs will not generate the assumed budget offsets and, perhaps more importantly, might reduce consumer welfare by restricting market entry and competition.

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