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Rural Hospital Ownership: Medical Service Provision, Market Mix, and Spillover Effects

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RESEARCH ARTICLE

Rural Hospital Ownership: Medical Service Provision, Market Mix, and Spillover Effects

Jill R. Horwitz and Austin Nichols

Objective. To test whether nonprofit, for-profit, or government hospital ownership affects medical service provision in rural hospital markets, either directly or through the spillover effects of ownership mix.

Data Sources/Study Setting. Data are from the American Hospital Association, U.S. Census, CMS Healthcare Cost Report Information System and Prospective Payment System Minimum Data File, and primary data collection for geographic coordinates. The sample includes all nonfederal, general medical, and surgical hospitals located outside of metropolitan statistical areas and within the continental United States from 1988 to 2005.

Study Design. We estimate multivariate regression models to examine the effects of (1) hospital ownership and (2) hospital ownership mix within rural hospital markets on profitable versus unprofitable medical service offerings.

Principal Findings. Rural nonprofit hospitals are more likely than for-profit hospitals to offer unprofitable services, many of which are underprovided services. Nonprofits respond less than for-profits to changes in service profitability. Nonprofits with more for-profit competitors offer more profitable services and fewer unprofitable services than those with fewer for-profit competitors.

Conclusions. Rural hospital ownership affects medical service provision at the hospital and market levels. Nonprofit hospital regulation should reflect both the direct and spillover effects of ownership.

Key Words. Hospitals, rural health care, nonprofit, for-profit, hospital markets

The organizational landscape of hospital care in the United States is shifting once again. The Patient Protection and Affordable Care Act (PPACA) includes new regulation of nonprofit hospitals, including community benefit obligations and billing practice reform (PPACA 2010). Moreover, hospital conversions from nonprofit to for-profit ownership are on the rise again (Gold 2010). Since the last spate of conversions in the early 1990s, we have learned a great deal about the effects of hospital ownership in urban settings. However, despite claims that hospitals are the heart of rural health systems (Holmes et al. 2006)

and for-profit ownership may harm rural health services (Moscovice and Stensland 2002), researchers have largely studied ownership in the urban context.

The marked divergence between rural and urban health care makes it inappropriate to apply findings from one context to the other, and highlights the need for research into the particular effects of ownership on rural hospitals. Differences in urban and rural health care can be seen in insurance status (Lenardson et al. 2009), provider demographics (Reschovsky and Staiti 2005), case mix and government payment structures (Moscovice and Stensland 2002), and the relatively high government hospital market penetration in rural markets (Table 1). For these reasons, as well as the fact that roughly half of all U.S. hospitals are located outside of metropolitan statistical areas (MSAs), we examine the direct and spillover effects of hospital ownership on the availability of medical services in rural areas.

First, we provide new descriptive information on for-profit and nonprofit market share in rural markets. We also identify systematic differences in the characteristics of geographic areas in which for-profits and nonprofits locate, patterns that are particularly important to consider when analyzing the effects of rural hospital ownership on hospital behavior. Previous studies concluding that rural for-profit hospitals have better controlled labor and other operating costs (McCue 2007) or are otherwise more efficient (Ferrier and Valdmanis 1996) than either nonprofit or government hospitals acknowledge the importance of location. But these studies address neither the variation in population density within nonurban areas nor related selection effects. Second, using regression analysis, we identify two distinct types of ownership effects: (1) the direct effects of a rural hospital's own ownership on medical service offerings and (2) the spillover effects of the market mix of hospital types on a hospital's service offering.

Our strongest findings suggest that nonprofit hospitals are more likely than rural for-profit hospitals to offer unprofitable services, many of which are in short supply in rural areas. Nonprofits are also less responsive than for-profits to changes in medical service profitability. Moreover, nonprofit hospitals located in areas with more for-profit competitors act more like for-profit hospitals in terms of service offerings than do nonprofits located in areas with fewer for-profit competitors. It is unclear, however, whether these similarities are because nonprofits must make up for lost revenue due to cream skimming

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Table 1: Hospital Ownership (1988–2005) by Year and Rural Status

	Urban, Unweighted			*Urban, Weighted by Admissions*			*Rural, Unweighted*			*Rural, Weighted by Admissions*		
Year	*Gov*	*NFP*	*FP*	*Gov*	*NFP*	*FP*	*Gov*	*NFP*	*FP*	*Gov*	*NFP*	*FP*
1988	17.91	64.46	17.63	17.39	73.12	9.49	43.17	47.63	9.20	32.00	58.37	9.62
1989	17.69	64.79	17.52	16.93	73.56	9.51	43.16	47.81	9.03	31.68	58.51	9.82
1990	17.67	65.22	17.10	16.80	73.74	9.46	43.13	48.02	8.85	31.63	58.53	9.83
1991	17.39	65.94	16.67	16.24	74.51	9.25	43.58	47.71	8.71	31.02	59.01	9.97
1992	17.83	65.62	16.54	16.27	74.43	9.29	43.73	48.41	7.85	31.16	59.84	9.00
1993	18.27	65.05	16.67	16.68	73.95	9.38	43.60	48.74	7.66	30.82	60.16	9.02
1994	18.11	64.51	17.37	16.80	73.03	10.18	42.05	50.35	7.60	26.55	65.74	7.72
1995	17.61	64.60	17.79	16.21	72.87	10.93	43.00	48.84	8.16	30.22	59.85	9.92
1996	17.64	64.36	18.00	15.75	72.54	11.71	42.83	48.94	8.23	29.54	60.18	10.28
1997	16.87	63.81	19.32	14.83	72.66	12.50	41.50	49.98	8.52	28.49	60.80	10.71
1998	16.28	64.89	18.83	14.00	73.54	12.46	40.68	50.67	8.65	27.82	61.57	10.62
1999	16.34	65.68	17.98	13.91	74.17	11.92	40.33	51.10	8.56	27.21	61.89	10.90
2000	15.72	66.01	18.27	13.25	74.43	12.31	39.76	51.83	8.41	26.83	61.98	11.19
2001	15.98	65.72	18.30	13.55	74.24	12.21	39.52	52.11	8.37	26.56	62.28	11.16
2002	15.93	65.69	18.38	13.67	73.95	12.37	38.76	52.67	8.57	25.70	62.89	11.41
2003	15.75	65.24	19.00	13.30	74.16	12.54	38.64	52.27	9.09	25.09	62.65	12.25
2004	15.79	64.58	19.63	13.54	73.69	12.77	38.43	52.00	9.57	25.33	62.11	12.56
2005	15.60	65.18	19.22	13.45	73.97	12.58	38.24	51.95	9.81	25.12	62.19	12.70
Average of all years	16.91	65.08	18.01	15.14	73.70	11.16	41.34	50.06	8.60	28.49	61.03	10.48

Notes. Includes all general, medical, and surgical hospitals except Veterans', Bureau of Indian Affairs, Department of Justice (prison), and other federal or restricted use hospitals. Rural hospitals are defined as those hospitals located outside of metropolitan statistical areas (MSAs) and urban hospitals are defined as those located within MSAs.

Source: Authors' analysis of American Hospital Association Annual Surveys 1988–2005.

by for-profit hospitals or because the characteristics of those markets favor that type of behavior. Given both the recent increase in hospital conversions and debate at all levels of government regarding whether nonprofit hospitals merit their tax exemptions, these results are both timely and important for understanding the potential effects of nonprofit and tax policy for health policy.

DATA

Hospital data are from the American Hospital Association's (AHA) Annual Surveys of Hospitals.[1] We construct control variables for market demographics

using tract-level data from the U.S. Census (1990 and 2000). Hospital reimbursement status variables are from the CMS Healthcare Cost Report Information System and the Prospective Payment System Minimum Data File. HMO data (1990–2001) are from the National Directory of HMOs and Interstudy (see Baker 1997 for details). We construct the hospital system membership variable from (1) the AHA and (2) databases by Madison (2004) and Dafny and Dranove (2006). Finally, we rely on a hospital address and coordinate database we constructed from the AHA, geocoding software, and extensive primary research.

Hospital Population, Key Study Variables, and Market Definitions

We include all nonfederal, general medical, and surgical hospitals in the continental United States in the study. We define rural hospitals as all those that fall outside of MSAs, a characterization typical of rural hospital research. As discussed below, we also include a control variable to account for varying degrees of rural status based on population density.

Our dependent variable is an indicator variable for whether a hospital offers a medical service. We examine all acute and postacute medical service reported in the AHA, which includes approximately 80 service questions; we exclude questions about facilities, nonmedical services, and duplicate questions (see Appendices SA2, SA3, and SA4 for a full list of services). We also exclude services that fewer than 3 percent of rural hospitals offer over the whole study period (including profitable services, e.g., open heart surgery, and unprofitable services, e.g., burn units) as well as services for which a majority of years are missing. This leaves 37 medical services.

Drawing on extensive prior research, we categorize the medical services as relatively high, relatively low, or variably profitable over the study period (Horwitz 2005a, b). We do not know the accuracy of these designations for each individual hospital or market; however, they are consistent with expert views, scholarship, and federal and state policy. Two advantages of the approach are (1) the designations rely in part on market perceptions rather than whether the services proved to be profitable ex post, thereby reflecting decisions to invest in service lines; and (2) our results do not rely on the designation of any single service but on comparisons among all major medical services.

The key explanatory variable for estimating the effects of hospital ownership on a hospital's own output is a dummy variable for nonprofit, for-profit, or government ownership. The key explanatory variable in estimating spillover effects is the interaction between ownership and for-profit market share. Using each hospital's longitude and latitude, we define a hospital's market

based on the distance to each potential competitor. We report results using a "distance-weighted" market measure, one that identifies the percent of all other potentially competing hospitals (i.e., all hospitals in the nation weighted by their distance, more or less as "the crow flies," from the observation hospital) that are for-profit.[2] Elsewhere we have shown this procedure produces results equivalent to less precise approaches to defining markets such as radii around a hospital's zip code or MSA (Horwitz and Nichols 2007).

Because a large proportion of hospitals are not located near a for-profit, we define "for-profit markets" as being in a "high for-profit market" (High-FP Mkt) if at least 5 percent of nearby hospitals' admissions are at a for-profit (i.e., the mean of neighbors' for-profit status weighted proportionally to admissions and approximately inversely proportionally to distance exceeds 0.05).[3] Thirty-six percent of rural hospitals are in a for-profit market. Seventy-one percent of for-profits, 43 percent of government, and 26 percent of nonprofits are located in a for-profit market. This definition excludes the hospital's own status, so the differential implies that rural for-profit hospitals are more likely to be located near other for-profit hospitals than are rural nonprofit hospitals.

STATISTICAL ANALYSIS

The Direct Effects of Ownership on Rural Hospitals

Service-Level Specification. In our main specification, we include all medical services provided at all hospitals in the sample in a single regression where each observation is a medical service–hospital–year combination. For reasons discussed in detail below, all of our main specifications are cross-sectional; in sensitivity testing, also described below, we use fixed-effects models. We regress service provision on hospital, market, and service characteristics as follows:

$$E(\text{ServiceProvided})_{ijt} = \beta_o + \beta_1 F_{it} + \beta_2 Y_t + \beta_3 H_{it} + \beta_4 D_{jt} + \beta_5 R_{jt} + \beta_6 P_{jt} + \beta_7 F^*_{it} P_{jt} \quad (1)$$

where j indexes medical services, i indexes hospitals, and t indexes year. The matrix F contains a set of indicator variables for nonprofit, for-profit, or government ownership. The matrix Y contains a set of dummy variables for years. Control variables in H_{it} include hospital characteristics and other variables described below. D includes demographic characteristics of the hospital's potential patient population, as described below.

P_{jt} is an indicator of service profitability (0 for unprofitable, 1 for profitable each year). The key variable is $F^*_{it} P_{jt}$ (coefficient β_7), the interaction between

ownership and service profitability, which suggests the probability of a hospital of a given type to offer relatively profitable and unprofitable services. In this model, we include all 31 services classified as either profitable or unprofitable, excluding the six services of indeterminate profitability. We code services with variable profitability as either profitable or unprofitable depending on the year.

To control for potential confounding factors, we include a set of hospital, market, and payment characteristics. Hospital characteristics, H, include (1) hospital size (measured by quintiles of hospital admissions, which is a better measure of size than the number of beds in a hospital because beds may or may not be filled and may or may not be licensed), (2) teaching status (measured by membership in residency training organizations), and (3) hospital system membership.

We also include the market penetration of HMOs, as a proxy for competitive pressure. We include two variables to control for market concentration, Herfindahl–Hirschman Index (sum of squares of each hospital's annual share of total admissions within each state among rural hospitals only), and whether the state has 2, 3, 4, or 5 or more rural hospitals.

We include *D*, a vector of demographic variables, measuring the characteristics of a hospital's potential patients, including population measures of size, age, education, race, sex, marital status by sex, employed persons by industry (as a proxy for insurance status), household income, income per capita, and travel time to work (as a proxy for willingness to drive to the hospital). Because these data were from the decennial censuses, we linearly interpolate and extrapolate the natural log of each control variable. We compile these data from the 1990 and 2000 Censuses by averaging across all tracts in the states and DC, using weights that vary inversely with the distance squared from hospital i to the centroid of each census tract.

R includes two sets of variables that address the unique nature of rural hospital markets and payments. First, we include a dummy variable for each quartile of 1989 population density in the vicinity of a hospital, weighted as with other Census-based controls so a nearer tract's population density contributes more than more distant tracts. These variables proxy for the degree of ruralness in the market and reflect the fact that there is a spectrum of market types between rural and urban designations.

Second, R includes dummy variables for federal designation as a Critical Access Hospital (CAH), a CMS program that reimburses hospitals through a cost-based rather than prospective-payment system.[4] Including the CAH variable is important because participating hospitals tend to have considerably higher revenues, expenses, and profit margins, particularly associated with

outpatient care, than nonparticipating hospitals.[5] Moreover, although some CAHs are for-profit—none in early years, 41 for-profit hospitals in 2005, and 2 percent of our sample overall—CAHs are typically nonprofit (Pink et al. 2006) or government hospitals. Eight percent of the nonprofit and 9 percent of the government hospitals in our sample were CAHs.

To further account for potential differences in reimbursement status, we include indicator variables to sole community hospitals (SCHs) or Medicare-dependent hospitals (MDHs) designation.[6] Because PPACA extends some of these rural payment programs, they will likely continue to affect rural medical service provision (PPACA 2010, Part II).

Because the probability of a hospital offering a service is not independent from one year to the next, we correct standard errors by clustering at the hospital level, a conservative choice, so they are robust to arbitrary serial correlation (Arellano 1987; Kézdi 2004; Stock and Watson 2006). These cluster-robust standard errors are also robust to heteroskedasticity in errors.

Individual Service, Hospital-Level Specification. We also estimated a separate probit for each of the medical services in our study. We estimated a hospital-level specification to ask whether hospital types (nonprofit, for-profit, government) offer different types of medical services as follows:

$$E(\text{ServiceProvided})_{it} = F(\beta_o + \beta_1 F_{it} + \beta_2 Y_t + \beta_3 Y_t^* F_{it} + \beta_4 H_{it} + \beta_5 D_{it} + \beta_6 R_{it}) \quad (2)$$

where i indexes hospitals, t indexes year, and $F(\,)$ is the probit function. All other variables are as described above.

After estimating the effect of ownership using equation (2), we predict the probabilities reported in Appendices SA2, SA3, and SA4 by varying only the corporate form and market type of each hospital observed in the middle year of 1996 while holding the independent variables constant (at 1996 levels). We then average the individual predicted probabilities to obtain the probability that a hospital type offers a service each year. Conducting the empirical tests in this manner allows us to hold constant nonownership hospital characteristics, thus yielding more accurate predictions of how hospitals would behave if they changed form and no other attributes.

The Spillover Effects of Ownership on Rural Hospitals

Service-Level Specification. We then estimate a spillover-based specification in which we whether hospital types offer different types of services in different

market types measured by for-profit penetration, modeling the effect of ownership mix on service provision by hospital type as follows:

$$E(\text{ServiceProvided})_{ijt} = \beta_o + \beta_1 F_{it} + \beta_2 Y_t + \beta_3 H_{it} + \beta_4 D_{jt} + \beta_5 R_{jt} + \beta_7 F^*_{it}\text{FPMarket}_{it} + \beta_8 P_{jt} + \beta_9 F^*_{it} P_{jt} + \beta_{10} P^*_{ijt} F^*_{it}\text{FPMarket}_{it} \quad (3)$$

where all the variables are the same as in equation (1) above, with the addition of variables to account for ownership spillover effects. We include FPMarket, an indicator variable for high for-profit markets, interacted with the hospital's own ownership type (matrix F). The key additional variable, $P^*_{ijt}F^*_{it}$ FPMarket$_{it}$(coefficient β_{10}), measures the differential impact of profitability for a hospital of a given type between low and high for-profit markets. As in the previous model, we correct standard errors by clustering at the hospital level.

Single Service, Hospital-Level Specification. Finally, we estimate a market-level model to the probability of a hospital offering each individual service, analogous to the hospital-level specification in equation (2)

$$E(\text{ServiceProvided})_{it} = \beta_o + \beta_1 F_{it} + \beta_2 Y_t + \beta_3 Y^*_t F_{it} + \beta_4 H_{it} + \beta_5 D_{it} + \beta_6 R_{it} + \beta_7 \text{FPMarket}_{it} + \beta_8 F^*_{it}\text{FPMarket}_{it} + \beta_9 Y^*_t F^*_{it}\text{FPMarket}_{it} \quad (4)$$

As with the results from equation (2), we use the estimates to predict the effects of ownership and market mix on service provision by varying only the corporate form and market type of each hospital observed in the middle year of 1996 while holding the independent variables constant (at 1996 levels). We then average the individual predicted probabilities to obtain the probability that a hospital type offers a service each year.

RESULTS

Descriptive Results

Like their urban counterparts, most rural hospitals are nonprofit. The distribution of ownership types, however, differs considerably. Rural hospitals are less likely than nonrural hospitals to be either nonprofit or for-profit corporations (see Table 1). From 1988 to 2005, rural hospitals were 50.06 percent

nonprofit, 41.34 percent government, and only 8.60 percent for-profit owned. Weighting by hospital admissions to account for hospital size, rural hospitals were 61.03 percent nonprofit, 28.49 percent government, and 10.48 percent for-profit owned. As this distribution implies, nonprofit and for-profit hospitals tend to be larger than government hospitals.

Not surprisingly, rural hospitals are farther from their nearest potential competitor (the nearest hospital) than are urban hospitals. Rural for-profits are closer to their nearest competitors than are either government or nonprofit hospitals, although these differences are not large. Half of for-profits face a nearest competitor 12 miles away or less, whereas half of nonprofits have their nearest competitor 15 miles away or less. Further, rural are more likely than nonrural for-profits to operate near another for-profit; rural are *less* likely than urban nonprofits to have a for-profit nearest neighbor. These geographic differences suggest different competitive strategies in rural and urban settings.

Direct Effects of Ownership Type. For-profit hospitals offer fewer services than do nonprofit hospitals in rural markets, even controlling for hospital size and the other factors listed above, but the difference is much more pronounced for unprofitable services. This can be seen in Table 2a, where a negative coefficient on for-profit hospital (FP Hospital) indicates lower probability of offering an unprofitable service than reference group nonprofit hospitals, and the coefficient on the interaction with profitable service is not large enough to offset that negative coefficient.

Nonprofit hospitals are *less* likely than for-profit hospitals and *more* likely than government hospitals to offer profitable services. This can also be seen in Tables 2a and b where coefficients on the interactions between the dummy variable of service profitability (ProfServ) with ownership types are all negative for the interactions with government hospital ownership and positive for the interactions with for-profit ownership type. We present estimates from linear regressions to facilitate comparisons with the fixed effect results with minimal distributional assumptions; generalized linear models tailored to binary outcomes produce similar marginal effects estimates.

To help illustrate our results, we present two examples from the specifications in which we tested the relationship between ownership and service provision by each individual service (equation [2]). Although the results for many of the services are similar, particularly for unprofitable services, there is some variation in the results by service. For a full list of the results by service see Appendices SA2, SA3, and SA4.

Table 2a: Provision of More and Less Profitable Services by Hospital Ownership, 1988–2005

	Dependent Variable = Probability of Offering Medical Service				
	(1) No Fixed Effects	*(2) No Fixed Effects*	*(3) Hospital Fixed Effects*	*(4) Hospital/Service Fixed Effects*	*(5) Hospital/Service Fixed Effects*
Profitable Service	−0.0221***	−0.0221***	−0.0221***	0.0619***	0.0619***
	(−6.25)	(−6.25)	(−6.26)	(12.82)	(13.70)
FP Hospital	−0.0867***	−0.0943***	−0.0339***	−0.0273***	−0.0273***
	(−11.82)	(−12.88)	(−4.64)	(−3.37)	(−4.59)
FP Hospital × ProfServ	0.0669***	0.0669***	0.0669***	0.0518***	0.0518***
	(7.35)	(7.34)	(7.34)	(4.70)	(6.16)
Gov Hospital	−0.0189***	−0.0224***	0.0140***	0.0123**	0.0123***
	(−4.13)	(−4.85)	(3.02)	(2.43)	(3.06)
Gov Hospital × ProfServ	−0.0191***	−0.0191***	−0.0190***	−0.0155***	−0.0155***
	(−4.08)	(−4.08)	(−4.06)	(−2.64)	(−3.11)
Fixed effects	None	None	Hospital	Hospital/service	Hospital/service
Dem. & rural controls	All	Limited	Limited	Limited	Limited
Observations	1,098,981	1,098,981	1,098,981	1,098,981	1,098,981
Clustered	By hospital	By hospital	By hospital	By hospital	By service

Notes. The unit of observation is the service-hospital-year. The specification in column 1 corresponds to equation (1). The results in column (2) and the fixed-effects specifications reported in columns (3)–(5) correspond to equation (1), with the exception that they do not include demographic or rural control variables as they would contribute noise to the estimation and increase measurement error bias, given the fixed effects structure; column (2), which reports the cross-sectional results with the same limited control variables as columns (3)–(5), is offered for comparison to column (1). All specifications are estimated as linear regressions. *t*-Statistics in parentheses.

***Significant at the 1 percent level.

**Significant at the 5 percent level.

*Significant at the 10 percent level.

For-profit are less likely than nonprofit and government hospitals to offer psychiatric emergency care, a service that was unprofitable relative to other services throughout the study period. On average from 1988 to 2005 in rural areas, for-profit hospitals were almost 9-percentage points less likely than nonprofit hospitals (12.78 versus 21.62 percent, $p<.01$) to offer psychiatric emergency services[7] (see Appendix SA3). Nonprofit hospitals were not significantly more likely than government hospitals (21.62 versus 18.36 percent, $p>.10$) to offer psychiatric emergency services (see Appendix SA3). It is easiest to see this graphically in Figure 1.

A second example is also instructive. The profitability of home health care varied dramatically over the study period. During the time that home health was

Table 2b: Provision of More and Less Profitable Services by Hospital Ownership and Market Type, 1988–2005

	Dependent Variable = Probability of Offering Medical Service				
	(1) No Fixed Effects	*(2) No Fixed Effects*	*(3) Hospital Fixed Effects*	*(4) Hospital/Service Fixed Effects*	*(5) Hospital/Service Fixed Effects*
Profitable Service	−0.0298***	−0.0298***	−0.0299***	0.0538***	0.0538***
	(−7.36)	(−7.36)	(−7.38)	(10.60)	(11.45)
FP Hospital	−0.103***	−0.109***	−0.0451***	−0.0325***	−0.0325***
	(−7.62)	(−8.02)	(−3.39)	(−2.61)	(−3.93)
FP Hospital & ProfServ	0.0950***	0.0948***	0.0948***	0.0666***	0.0666***
	(5.46)	(5.44)	(5.44)	(4.99)	(5.56)
Gov Hospital	−0.0169***	−0.0189***	0.0184***	0.0142**	0.0142***
	(−3.03)	(−3.36)	(3.34)	(2.38)	(3.15)
Gov Hospital & ProfServ	−0.0230***	−0.0230***	−0.0229***	−0.0144**	−0.0144***
	(−3.93)	(−3.93)	(−3.91)	(−2.22)	(−2.59)
HiFP Mkt & Gov Hosp & ProfServ	−0.0138***	−0.0163***	0.0115***	0.00764*	0.00764**
	(−2.86)	(−3.39)	(2.74)	(1.86)	(2.25)
HiFP Mkt & Gov Hosp & Unprof Serv	−0.0413***	−0.0438***	−0.0160***	−0.0125***	−0.0125***
	(−7.75)	(−8.16)	(−3.96)	(−3.12)	(−3.80)
HiFP Mkt & FP Hosp & ProfServ	−0.0305**	−0.0314**	−0.0165	−0.00283	−0.00283
	(−2.30)	(−2.31)	(−1.31)	(−0.27)	(−0.35)
HiFP Mkt & FP Hosp & UnprofServ	−0.00163	−0.00264	0.0122	0.000319	0.000319
	(−0.11)	(−0.18)	(0.94)	(0.03)	(0.04)
HiFP Mkt & NFP Hosp & ProfServ	−0.0259***	−0.0302***	0.0179***	0.0150***	0.0150***
	(−4.50)	(−5.29)	(3.84)	(3.78)	(4.42)
HiFP Mkt & NFP Hosp & Unprof Serv	−0.0558***	−0.0601***	−0.0122***	−0.0101**	−0.0101***
	(−8.42)	(−8.99)	(−2.73)	(−2.37)	(−3.04)
					(17.87)
Fixed Effects	None	None	Hospital	Hospital/service	Hospital/service
Dem. & Rural Controls	All	Limited	Limited	Limited	Limited
Observations	1,098,981	1,098,981	1,098,981	1,098,981	1,098,981
Clustered	By hospital	By hospital	By hospital	By hospital	By service

Notes. The unit of observation is the service-hospital-year. The specification in column 1 corresponds to equation (3). The regression in column (2) and the fixed-effects specifications reported in columns (3)–(5) correspond to equation (3), with the exception that they do not include demographic or rural control variables as they would contribute noise to the estimation and increase measurement error bias, given the fixed effects structure; column (2), which reports the cross-sectional results with the same limited control variables as columns (3)–(5), is offered for comparison to column (1). All specifications are estimated as linear regressions. *t*-Statistics in parentheses.

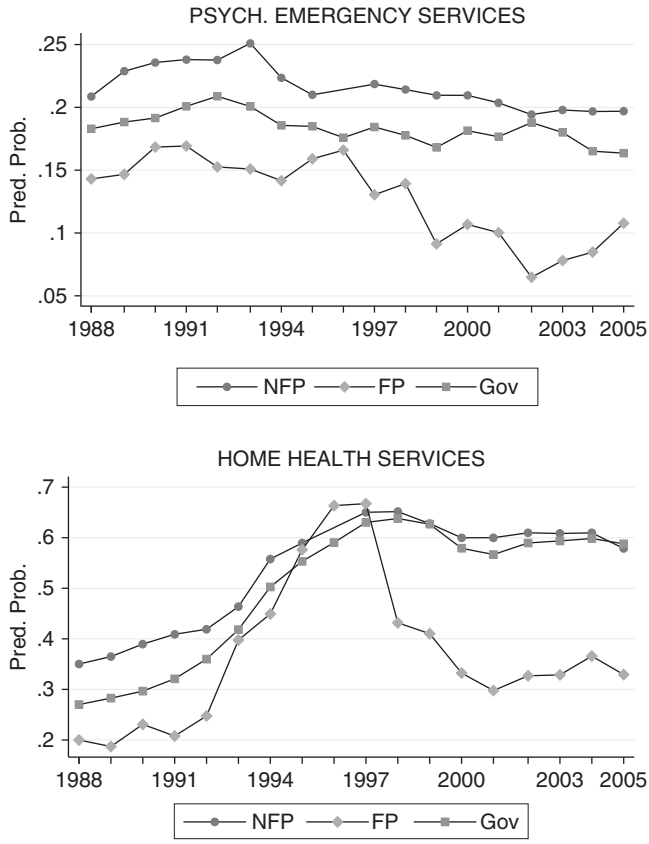
***Significant at the 1 percent level.

**Significant at the 5 percent level.

*Significant at the 10 percent level.

a profitable service (1988–1997), the likelihood a for-profit hospital offered home health rose more than threefold (the chance was 3.3 times as high, rising from under 20 to over 66 percent), while it nearly doubled at nonprofit hospitals (increasing from 35 to 65 percent; this difference in growth is statistically

Figure 1: Proportion Rural Hospitals Offering Services, 1988–2005, Regression Adjusted



Source: Authors' analysis of data from the American Hospital Association Annual Surveys, 1988–2005.

Notes: Probit predicted probabilities include all rural, general medical and surgical hospitals and control for all variables listed in the text.

significant, $p<.01$), and more than doubled at government hospitals (increasing from 27 to 63 percent, $p<.01$). As profitability decreased (from 1997 to 2005), the probability of offering home health care halved among for-profits (67–33 percent), but declined modestly at nonprofit (falling from 65 to 58 percent, $p<.01$) and government hospitals (falling from 63 to 59 percent, $p<.01$) (see Appendix SA4).

Ownership Mix and Spillover Effects. We also identify the indirect effects of hospital ownership on medical service offerings by examining the relationship between the mix of ownership types in rural markets and service offerings. Without any fixed effects, we find that nonprofit hospitals in markets with higher for-profit market penetration are less likely to offer unprofitable services than nonprofits in markets with lower for-profit penetration (Table 2b, columns [1] and [2], coefficient on HiFP Mkt × NFP Hosp × Unprof Serv).

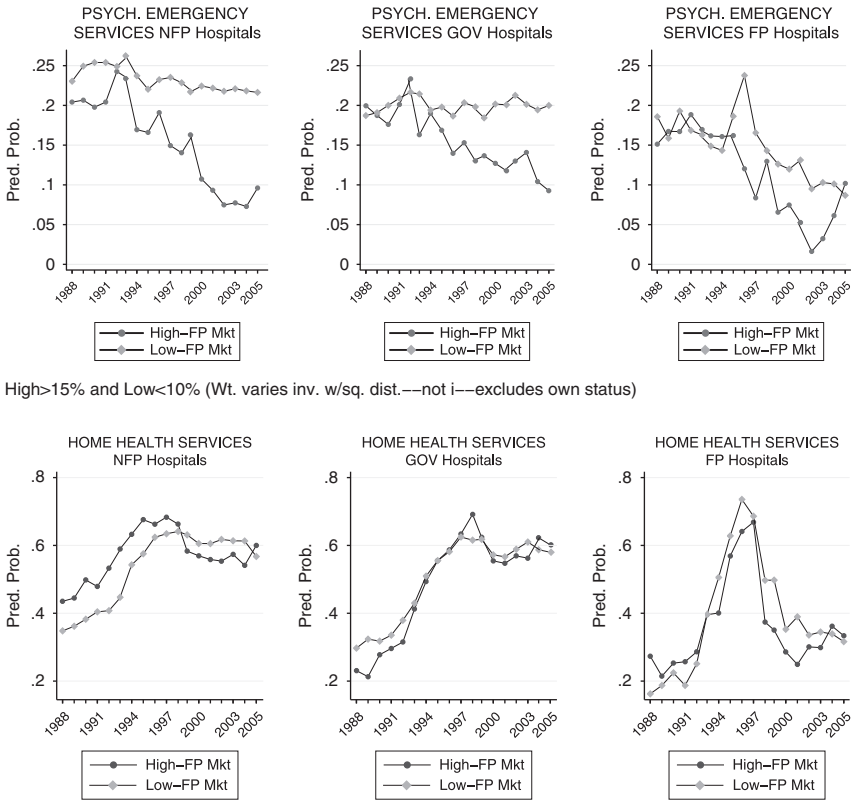
Without any fixed effects, we find that nonprofit hospitals in markets with higher for-profit penetration are also less likely to offer profitable services than nonprofits in markets with lower for-profit penetration (Table 2b, columns [1] and [2], coefficient on HiFP Mkt × NFP Hosp × Prof Serv). However, these results are not robust. Indeed, in the fixed effects tests (columns 3–5) the sign flips. This could be because markets in which ownership is in flux are different from more stable markets, or it could more accurately reflect the causal effect if the identification is superior using fixed effects to sweep out time-invariant differences across hospitals and/or services. Nonprofits consistently, in markets with either high or low for-profit penetration, do not contribute to the fixed effects estimates, so if the former are less likely to offer profitable services and the latter more likely due to historical factors and the differential service provision has actually induced the difference in for-profit penetration, the regressions without fixed effects could incorrectly attribute this cross-sectional difference to and effect of the market penetration rather the reverse.

The estimates from the individual service regressions were mixed. Although we find no clear pattern in the propensity to offer profitable services across market types, nonprofits with relatively few for-profit competitors were more likely to offer many unprofitable services such as psychiatric, hospice, substance abuse, and social work services (Appendices SA2, SA3, and SA4, columns 6 and 7). In addition, nonprofits in markets with more for-profit competition were more profit seeking in their provision of services where profits varied over time.

As with the direct effects results, it is easiest to understand the results by looking at representative services. On average over the study period, nonprofits in high for-profit markets were predicted to be 8.2-percentage points less likely to offer psychiatric emergency care than those in low for-profit markets (15.50 versus 23.27 percent, $p<.01$) (see Appendix SA3).

In addition, nonprofits in for-profit markets were more responsive to financial incentives than other nonprofits. Nonprofits were more likely to offer home health services over time in both high and low for-profit markets during

Figure 2: Proportion Rural Hospitals Offering Services, 1988–2005, Regression Adjusted and by Market Type



Source: Authors' analysis of data from the American Hospital Association Annual Surveys, 1988–2005.

Notes: Probit predicted probabilities include all rural, general medical and surgical hospitals and control for all variables listed in the text.

the profitable period of 1988–1997), but rose more dramatically in high for-profit markets (43.5–68.4 percent compared with 34.8–63.4 percent, Appendix SA4). As profit-making fell after 1997, nonprofits were less likely to offer home health in both types of markets, but the fall was more dramatic in high for-profit markets (falling from 68.4 to 60.0 percent instead of 63.4 to 56.7 percent, see Appendix SA). Nonprofits were more likely to offer home health in high than low for-profit markets during the profitable period (1988–1997)

and less likely to offer it in high than low for-profit markets during the unprofitable period (post-1997) (Figure 2, panel 4), though the difference between high and low for-profit markets in the nonprofit likelihood of offering home health during 1993–1997 is only marginally significant ($p = .586$).

Fixed Effects Models and Other Robustness Checks

The biggest challenge to studying hospital ownership is potential endogeneity of hospital location. We cannot rule out the possibility that an unobserved market trait—one which attracts for-profit hospitals and causes them to specialize in profitable services—explains our results. However, there are several reasons to suggest we have identified the effects of ownership. It is likely that the detailed demographic control variables used in our estimations are correlated with unobserved market demand characteristics. Moreover, although hospitals do open, close, and convert among ownership forms, market share changes little over time (Santerre and Vernon 2005) and is related primarily to historical and social characteristics (Grabowski and Hirth 2002; for more detail see Horwitz and Nichols 2007, 2009).

Nonetheless, we conducted additional analyses to test the robustness of our results. First, we redefined market type (high versus low for-profit market) based on the for-profit market penetration of the first year a hospital is observed in our data (typically 1988). The unreported results differ only modestly, suggesting that they do not reflect selective for-profit entry in markets with relatively high demand for profitable services.

Second, we implement specifications using hospital and hospital-service fixed-effects. In all fixed effects specifications we exclude the demographic and rural payment and population control variables because these variables are unlikely to change much over the sample period and, therefore, including them would likely only contribute noise to the estimates. Excluding the variables do not materially change the results in the cross-sectional specifications (compare columns [1] and [2] in Tables 2a and b).

In the fixed effects regressions much of the identification comes from changes in for-profit market share, although service profitability and ownership also change over time. Although fixed effects models may address locational endogeneity, it can be difficult to generalize from their results because markets and hospitals that change ownership form, particularly from nonprofit to for-profit ownership, are likely different from other hospitals and markets.

Nonetheless, the fixed effects estimates results support our findings. For example, for-profit hospitals are less likely to offer unprofitable services (Table

2b, column 2, row 2) and more likely to offer profitable services (Table 2b, column 2, row 3) than nonprofits in a low for-profit-penetration market. Similarly, the hospital-service-level fixed effects, which identify the effects off of services that change profitability in hospitals that change form, also support the results. Again, nonprofits are more likely than for-profits to offer these services when profitable, and less likely than for-profits to offer them when unprofitable (Table 2b, columns 3 and 4, row 2), and more likely to offer profitable services (Table 2b, columns 3 and 4, row 3) than nonprofits in a low for-profit-penetration.

Finally, some of our findings regarding the spillover effects of ownership are also supported by the fixed effects results. Nonprofit hospitals are more likely to offer profitable services in high for-profit penetration markets (Table 2b, columns 2 and 3, row 10) and less likely to offer unprofitable services in high for-profit penetration markets (row 11). Government hospitals also appear more likely to offer profitable services and less likely to offer unprofitable services in markets with high for-profit penetration (rows 6 and 7), though the apparent effects are not always statistically significant.

DISCUSSION

Despite the importance of identifying the relationship between ownership and medical services, ownership has not been studied previously among rural hospitals. Patient treatment is constrained by the range of services a hospital chooses to offer. Knowing whether and how ownership determines the availability of services, therefore, contributes to an understanding of access to medical care. Moreover, hospital administrators may more readily control service offerings than ownership status, market environment, physician behavior, or patient selection.

Our approach demonstrates that ownership affects service delivery, a finding that is often obscured by the research design typically used in ownership studies. For example, a study may conclude that patient mortality is the same at for-profit and nonprofit hospitals—even controlling for factors such as billing practices, capacity, staff, the patient pool, market characteristics, and service offerings. Such a study, however, would not allow one to conclude that ownership does not matter because it would mask the fact that nonprofits and for-profits offer different services, and these differences might matter a great deal for quality and access.

Further, even if the hospital types did not differ in service offerings—although we find that they do a great deal—the presence of nonprofits or for-profits in a market could, as we find, affect the distribution of services offered in a market. Therefore, the mix of ownership types could have

important consequences for the well-being of patients, government finances, returns on investment, and the economic efficiency of the market. Understanding the size of these potential effects is a necessary prerequisite to evaluating the potential benefits of different market structures for hospital care.

Yet policy makers, particularly those focused on tax exemption, have been focused elsewhere. As mentioned above, PPACA includes new requirements for nonprofit hospitals to maintain their federal tax exempt status such as conducting community health needs assessment every 3 years and implementing programs to address these needs. In addition, PPACA requires nonprofit hospitals to develop financial assistance policies, refrain from engaging in extraordinary collection activities, and limit billing before determining patients' eligibility for financial assistance. Whether these new rules will limit charges in practice is uncertain as PPACA includes a substantial modification to the original language in the Act: whereas section 9007 forbids nonprofit hospitals from charging individuals eligible for financial assistance who receive emergency or medically necessary care an amount "more than the lowest amounts charged to individuals who have insurance coverage," Section 10904 of the Act modifies this restriction by allowing hospitals to charge no more than "the amounts generally billed."

Investigations have largely centered on the differences between nonprofit and for-profit hospitals, particularly in the financial treatment of indigent patients (Grassley 2006; Pear 2006). However, differences in the amount of charity care provision are not the most significant differences in nonprofit and for-profit hospital behavior. Therefore, a tax policy too focused on charity care levels could be counter-productive for health policy because it may decrease resources available for other beneficial but low-profit, undersupplied medical services, particularly in rural areas that are already poorly served.

Policy proposals addressing hospital ownership, therefore, should be evaluated not only according to their effect on nonprofit hospital behavior. Rather, regulators should consider the reactions of competitors in mixed-ownership markets, which unfortunately, are not well understood. It may be that a nonprofit's biggest contribution is not that it offers underprovided services but that its presence influences the behavior of its for-profit competitors.

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NOTES

1. The AHA data have several limitations. First, they are self-reported and the survey format changed slightly over the years. From 1988 to 1993, it asked hospitals whether each service was offered at the hospital, another hospital, or not at all. Later surveys asked hospitals to answer four separate questions regarding whether the service was available at the hospital or at various affiliated entities. For all years, we converted the answers into a dichotomous variable representing whether the hospital itself offered the service. To ensure consistent coding, we compared the responses in 1993, when the surveys included both question types. Second, the data have missing values, particularly in the later years, with no obvious difference between nonprofit and for-profit respondents. We imputed about 1 percent of the observations for each service using data from the surrounding years. Third, in approximately 83 hospitals, the self-reported variable for whether a hospital is a general or specialty hospital was inconsistent across years. We recoded 183 cases (about 0.5 percent of our estimation sample) using the modal response during all sample years.
2. For each hospital in our sample in each year, we assign a weight to each other hospital in the nation (including both urban and rural hospitals), weighting by its admissions divided by the square of one plus a constant $\times$ the distance squared. This method places more reasonable relative weights on points of different distances from the hospital than does the reciprocal of squared distance, and it does not create a discontinuous drop in weight on neighbors from one to zero that using geopolitical or other boundaries would. We fix the constant used in the weighting such that the method yields similar results to those of actual patient markets. In addition, we used a geodesic distance calculated using an accurate ellipsoidal model of the earth's surface. For more detail, see Horwitz and Nichols (2007, 2009).
3. In sensitivity testing, we confirmed that the results are not sensitive to the precise definition of a for-profit market. For example, the results do not change appreciably if we define a for-profit market as one in which 10 percent of a hospital's competitors (weighted by distance and admissions) are for-profit.
4. To participate, hospitals must meet several criteria such as location in a rural location at a specified distance from the nearest hospital, operating no more than 25 beds, maintaining a low-average length of stay (no more than 96 hours), or designation as a "necessary provider" under a state waiver administered by the CMS program (CMS 2009). As of June 2010, there were 1,315 critical access hospitals (Flex Monitoring Team).

5. However, participation does not seem to change either the mix of inpatient and outpatient services or the balance between medical and surgical services within hospitals (Schoenman and Sutton 2008; Li, Schneider, and Ward 2009).
6. We determined whether a hospital had CAH, SCH, or MDH status from the Medicare cost reports, which indicates the beginning and end dates of payment status. When a hospital had a CAH, SCH, or MDH payment status for more than half the year, we coded the dummy variable as a one for that hospital-year observation.
7. By varying only the corporate ownership and market type of each hospital, while holding the other variables constant (at 1994 levels), we predict the probabilities that each hospital in each year.

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SUPPORTING INFORMATION

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

Appendix SA1: Author Matrix.
Appendix SA2: Average Predicted Probability of Offering Service by Type of Hospital, Profitable Services.
Appendix SA3: Average Predicted Probability of Offering Service by Type of Hospital, Unprofitable Services.
Appendix SA4: Average Predicted Probability of Offering Service by Type of Hospital, Variably Profitable Services (relatively profitable period 1993–1997).

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