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Health Care Markets

Revisiting the Relationship between Managed Care and Hospital Consolidation

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Objective. This paper analyzes whether the rise in managed care during the 1990s caused the increase in hospital concentration.

Data Sources. We assemble data from the American Hospital Association, InterStudy and government censuses from 1990 to 2000.

Study Design. We employ linear regression analyses on long differenced data to estimate the impact of managed care penetration on hospital consolidation. Instrumental variable analogs of these regressions are also analyzed to control for potential endogeneity.

Data Collection. All data are from secondary sources merged at the level of the Health Care Services Area.

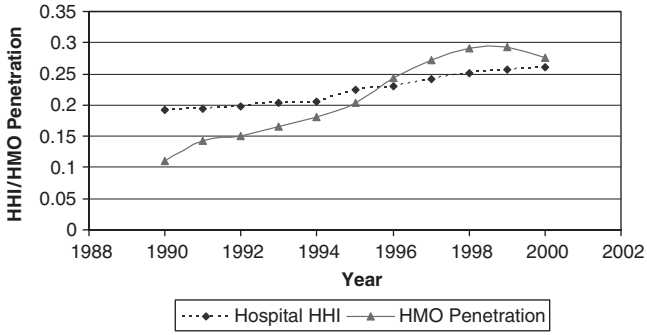
Principle Findings. In 1990, the mean population-weighted hospital Herfindahl–Hirschman index (HHI) in a Health Services Area was .19. By 2000, the HHI had risen to .26. Most of this increase in hospital concentration is due to hospital consolidation. Over the same time frame HMO penetration increased three fold. However, our regression analysis strongly implies that the rise of managed care did *not* cause the hospital consolidation wave. This finding is robust to a number of different specifications.

Key Words. Managed care, hospitals, mergers, consolidation, competition

During the 1990s, managed care displaced indemnity insurance to become the dominant form of health insurance in the private sector (Glied 2000). Over the same period, a wave of hospital mergers, acquisitions, and hospital system expansions occurred. In 1990, the mean, population weighted, hospital concentration, measured with the Herfindahl–Hirschman index (HHI)[1] in Health Services Areas (HSA) was 0.1913. By 2000, it had risen to 0.2596. Over 90 percent of the increase in concentration is a consequence of mergers, acquisitions, and hospital system expansions.[2]

Understanding the determinants of hospital market power allows the development of policies to manage hospital market power, which is important

Figure 1: Mean, Population Weighted Hospital Concentration, and HMO Penetration, 1990–2000



because hospital market power increases, this has negative effects on markets. First, as hospital market power improves hospitals' bargaining position with payers and increases the cost of hospital care for the privately insured population (Dranove and Satterthwaite 2000; Gaynor and Vogt 2000, provide excellent reviews of the literature studying this effect). Second, hospital market power is also associated with decreased hospital quality (Kessler and McClellan 2000; Gowrisankaran and Town 2003). Finally, there is some evidence that hospital market power decreases access to health services for underserved populations (Aizer, Currie, and Morretti 2004).

It is conventional wisdom that the rise of managed care precipitated the hospital consolidations and concentration in the 1990s.[3] Graphical analysis is consistent with conventional wisdom. Figure 1 graphs the mean, population-weighted levels of hospital HHI and HMO penetration across all HSAs.[4] Hospital concentration and HMO penetration share a common, upward trend throughout most of the 1990s. In the late 1990s there was a break in the relationship, as HMO penetration declined while hospital concentration continued to increase. While suggestive, the correlation does not prove that there is a causal link between HMO penetration and hospital concentration.

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This paper tests whether there is a causal relationship, examining the proposition that the rise of managed care caused hospitals to consolidate in the 1990s. Our models explicitly account for the possibility that markets are systematically heterogeneous and this heterogeneity may bias cross-sectional estimates of the parameters of interest.

Our estimates indicate that the rise in managed care did *not* cause the increase in hospital concentration. In every specification we estimated, the coefficients on managed care penetration are not different from zero at traditional levels of confidence. Furthermore, our data analysis fails to suggest other possible cause(s) of the hospital consolidation wave.

The next section discusses some of the reasons why managed care might lead to hospital consolidation. The following sections present the methods, data, results, and discussion of our findings.

Hospital Consolidation and Managed Care

Why Managed Care May Cause Hospital Consolidation

There are at least three reasons why managed care might cause hospital consolidation. First, managed care may reduce the demand for hospital beds and create excess capacity in the market. Second, managed care may change the bargaining power of hospitals relative to health insurers. Third, the value of contracting with an integrated hospital system may be greater for managed care organizations (MCOs) than indemnity insurers.

One of the theories underlying managed care is that by monitoring and controlling health care use, insurers can reduce health care expenditures and perhaps increase enrollee health. In the RAND health insurance experiment, enrollment in the prepaid Group Health Cooperative of Puget Sound reduced the likelihood of a hospital admission by 35 percent compared with a fee-for-service population (Manning et al. 1987).[5] However, as an explanation of hospital consolidation this finding needs embellishment because most economic models of mergers predict that the incentive to merge increases with the demand for the product (e.g., Deneckere and Davidson 1985). The intuition behind this result is straightforward—the larger the market the larger the profit gains from market power.

However, it is possible to conceive of circumstances in which a decline in demand for inpatient services leads to hospital consolidation. If demand falls far enough so the market can no longer support the old number of hospitals under the old ownership structure, then there may be an incentive to merge.

According to neo-classical economic theory, if the reduction in demand leads to lower prices and if price falls below average variable cost, the market will remove capacity in some way. Hospital closure is one way to reduce capacity. But, because hospital assets have "high specificity" and few alternative uses, hospitals may seek to raise price above average cost by combining operations in order to achieve efficiencies which reduce average costs and/or to use market power to raise prices. This explanation requires that hospitals value autonomy as well as profits. If autonomy were not valued, the hospitals would have been better off by consolidating earlier. Given the hospital industry's historical basis as a decentralized, community-based system, the assumption of autonomy being valued is plausible.

The second reason that increases in managed care might trigger hospital consolidation is based on the ability of MCOs to bargain effectively with hospitals over prices. By selective contracting, MCOs increase their bargaining leverage with hospitals vis-à-vis indemnity plans, increasing the price elasticity of demand for hospital services. This explanation applies to a broad shift in contracting practices that may have been initiated by the rise of HMOs and were subsequently adopted by other forms of managed care and non-managed care health insurance plans. However, the effect of increasing the price elasticity of demand on the benefits of consolidation is theoretically ambiguous.

The third possible reason why managed care may increase hospital consolidation is that by forming an integrated delivery system the hospitals are better able to manage patient care and better able to engage in capitation arrangements with health plans. Better management occurs through vertical (with physician groups) and horizontal (with other hospitals) arrangements that can manage care for a geographically dispersed population. MCOs then contract with the integrated delivery systems, delegating care management to the integrated delivery system. But, the development of integrated delivery systems is a weak explanation for the effect of managed care on hospital consolidation. Capitated hospital arrangements never became widespread and integrated delivery systems ultimately "did not work" (Burns and Pauly 2002).

Empirical Evidence

There are three studies of the relationship between managed care penetration and hospital market competition/hospital propensity to merge. Dranove, Simon, and White (2002) (DSW) use data on physicians' reports of managed

care revenue and find that the change in hospital concentration in 68 large metropolitan statistical areas (MSAs) between 1981 and 1994 is positively correlated with the level of managed care concentration in 1993/1994. This research has some limitations. First, the time period of the analysis is terminated before most of the hospital consolidations and increase in managed care in the 1990s. Second, DSW focus on large metropolitan areas in which hospital mergers are less likely to lead to significant increases in market power. The mean end-of-period HHI they report is 0.126—well below concentration levels that would give the Federal Trade Commission or the Department of Justice cause for concern.[6] Third, the measure of managed care penetration is the mean percent of physician practice revenues from managed care. This measure is not widely used and does not directly capture the more commonly used measure of product market penetration.[7] The measure is also a function of physician prices in a location and may be more subject to endogeneity problems than simple managed care penetration rates. However, an important advantage of DSW's measure is that it includes all forms of managed care, not just HMOs. Fourth, DSW regress the change in concentration on the end-of-period *level* of managed care penetration. They argue that this is a reasonable approach because managed care penetration in most cites was close to zero at the beginning of their sample. However, in this type of statistical analysis, the difference between being "close" to zero and being exactly zero can matter. Failure to difference a variable can still lead to bias due to measurement error. The magnitude of the bias will be a function of the average size of the error and the correlation between the error and the unobservable, market-specific component of hospital concentration. We replicate and discuss the DSW results in greater detail in "Results."

Sloan, Ostermann, and Conover (2003) use individual hospital data to study the factors associated with merger, closure, and conversions. They find no significant association between market-level HMO penetration and the likelihood that a hospital will merge. Chernew (1995) analyzes the relationship between the change in the number of hospitals and managed care penetration in 175 large MSAs between 1982 and 1987. He finds a negative and significant relationship between managed care penetration and the number of hospitals in an MSA. Like DSW, Chernew's analysis occurs before the rise in managed care. Also, Chernew's analysis does not explicitly focus on changes in market structure due to consolidation. The number of hospital competitors in a market can change due to consolidation (although a consolidation does not necessarily change the physical number of hospitals in a location) or because of entry or exit.

METHODS

We estimate the impact of managed care on hospital consolidation by relating the change in HMO penetration to one of several possible measures of hospital concentration change. Using a model similar to DSW, we assume that hospital concentration is related to contemporaneous HMO penetration:

$$H_{it} = \alpha_i + HMO_{it}\beta_t + x'_{it}\gamma_t + e_{it} \quad (1)$$

where H_{it} is the hospital concentration in market i at time t, HMO penetration is denoted by HMO_{it}, x_{it} is a vector of market characteristics, α_i is a time-invariant unobserved (to the researcher) market fixed effect, and e_{it} is a market/time shock. In some specifications we replace HMO_{it} with the current number of HMOs operating in the HSA. We let β_t depend on time as changes in technology or unmeasured market conditions may affect the incentive for hospitals to consolidate in response to managed care.[8] We also estimate a specification that uses 2-year lagged values of HMO penetration allowing for the possibility that hospitals respond with a lag to HMO penetration.

It is possible that the unobserved market fixed effect is correlated with HMO penetration. There are many possible reasons for this correlation. For example, locations in which hospitals have high α's may be unattractive for HMOs to enter because they have few hospitals with which to contract. If α is correlated with HMO penetration, ordinary least squares (OLS) estimation of (1) will lead to biased estimates of β_t. This bias can be eliminated by taking differences of (1) across time.

Taking differences between period t and period $t-1$ gives

$$\Delta H_{it} = \Delta HMO_{it}\beta_t + HMO_{it-1}\beta^e + \Delta x'_{it}\gamma_t + x'_{it-1}\gamma^e + u_t \quad (2)$$

where Δ is the standard difference operator (i.e., $\Delta H_{it} \equiv H_{it} - H_{it-1}$), $\beta^e = \beta_t - \beta_{t-1}$, $\gamma^e = \gamma_t - \gamma_{t-1}$, and $u_{it} = e_{it} - e_{it-1}$.

We use a long difference of 10 years to define our change variable, with 1990 as the base year.[9] We chose 1990 as the starting year because that is the approximate beginning of the horizontal (within market) consolidation wave. The mean, population-weighted increase in the HHI between 1985 and 1990 was 0.0007—a very small difference over the 5-year period. However, the increase in average HHI between 1990 and 1991, the years of the smallest increase in our sample, was 0.0035, a rate of increase that is approximately 25 times larger than the annual rate of increase over the preceding 5 years.

Measures of the Change in Concentration

The most common measure of competition used by economists is the HHI. The HHI is the sum of the squared market shares of all firms in a market:

$$HHI_{it} = \sum_{i=1}^{N} s_{it}^2 \tag{3}$$

where s is the market share of the hospital system within the market, $s_{it} \equiv q_{it}/\sum_{j=1}^{N} q_{jt}$, and q is a measure of output/capacity while N is the number of market participants. The HHI will change with entry, exit, and shifts in the distribution of shares across hospitals. In order to control for changes in the HHI that are unrelated to consolidation (which is the phenomena of interest), we include counts of the number of entrants and exits in the list of control variables.

We made two important decisions in calculating HHI. The first concerns the boundaries (both geographic and product) of the market. As we discuss in the data section, we use HSA as the geographic boundary and short-term, nongovernmental inpatient care as the product market. We tested the sensitivity of this decision by repeating our analysis using HHI constructed from using the MSA as the geographic boundary. Our findings are insensitive to this decision.[10]

The second concerns the appropriate measure of output. Our primary measure of output is the total number of staffed beds. We tested the sensitivity of this decision by estimating the parameters using three alternative HHI measures. First, we use a HHI measure based on inpatient days. Second, we formulated a "Strong HHI" measure by treating only hospitals that are owned by a centralized system as a single firm. These are identified as hospitals with the same American Hospital Association (AHA) ID. Third, because HHI can change for reasons unrelated to consolidation (e.g., the distribution of output/capacity changes or there is entry into or exit from the market), we form a HHI measure (ΔMHHI) that changes only when the ownership/system membership changes. ΔMHHI is defined as

$$\Delta MHHI_{it,r} = \sum_{i=1}^{N_r} s(O_t)_{ir}^2 - \sum_{i=1}^{N_r} s_{ir}^2 \tag{4}$$

where $s(O_t)_{ir}^2$ is the share based on the distribution of output/capacity from period r aggregated to the hospital using the ownership/system structure in period t $(r < t)$.

Robustness Analysis

The long difference approach removes any time-invariant, market-level unobserved factors that may affect concentration. However, it is still possible that time varying factors (i.e., the error term in (2)) are correlated with our measures of HMO penetration, and if so, our estimates will be biased. We attempt to examine the sensitivity of our conclusions to this possibility by using an instrumental variables approach.

We use as instruments the number of nonspecialist physicians per capita in 1990, the percent of one-employee firms, the percent of the firms that have between one and five employees, and the percent of firms with over 50 employees in 1990. These variables are plausibly unrelated to changes in hospital market structure and they predict HMO penetration.

We hypothesize that HMOs will have more bargaining power and consequently lower costs of doing business in markets with higher numbers of primary care physicians per capita. Baker and Brown (1999) used the size distribution of employers to instrument for HMO penetration in their analysis of the impact of managed care on mammography providers.

It is well known that if the instrument set is a poor predictor of the endogenous variables conditional on all of the control variables, then small-sample bias can be very large (Stock and Staiger 1997). Following the suggestion of Stock and Staiger (1997) and Bound, Jaeger, and Baker (1995), we performed *F*-tests of the joint significance of the instrument set for the endogenous variables, ΔHMO Penetration and HMO Penetration. The *F*-statistics are 2.63 and 4.50 for the regressions with corresponding *p*-values of .03 and .001, respectively. Both of these *F*-statistics are significantly greater than 1—a value below which that Bound, Jaeger, and Baker (1995) suggest should be "a cause for concern."[11]

Data

An observation in our analysis is an HSA, defined by the National Center for Health Statistics (Makuc et al. 1991) as one or more counties that are relatively self-contained with respect to the provision of routine hospital care. This definition is operationalized by using an algorithm that groups counties by minimizing travel by patients within the area to areas outside of the defined group. Thus, unlike MSAs, the HSA relies on patient flows instead of geopolitical boundaries to identify hospital "markets."[12]

This definition is not ideal. The ideal unit of observation for our study would be an antitrust market. However, defining antitrust markets is

notoriously difficult. It requires detailed analysis of each hospital under consideration, and there is still substantial disagreement within the economic and legal communities on the appropriate methodology to use (Werden 1990; Capps et al. 2002). While it is important to recognize that HSAs are not antitrust markets, they are probably a closer approximation to them than MSAs. Most economists believe that antitrust markets typically are smaller than MSAs, and HSAs, on average, are significantly smaller than MSAs.

The data in this study come from several sources. Data on hospitals come from the AHA hospital survey which contains information on hospital location, size (beds and inpatient days), and system membership. AHA system membership information contains some inaccuracies. We use a "corrected" AHA system ID constructed by Kristin Madison which has been updated by researchers at Carnegie Mellon University.[13] See Madison (2004) for more information on this data. The AHA survey also tracks mergers and acquisitions of different hospitals in an appendix. In most of the analysis, we use data from 1990 to 2000 but in some of our analyses we used data from the 1985 hospital survey. Each hospital is assigned to an HSA according to its address in the 1990 AHA Survey.

Our information on HMO penetration and the number of HMOs operating in an HSA comes from InterStudy. InterStudy collects information on the number of HMO enrollees by health plan. The HMO data come from InterStudy census data (InterStudy 1985–1987, 1988–2001) and Group Health Association HMO Directories (Group Health Association of America 1989–1992). The InterStudy data are used to form county-level measures of HMO penetration and the number of HMOs following the methodology of Wholey, Engberg, and Bryce (2006). County-level market measures come from the Area Resource File (ARF, Bureau of Health Professions 1999). State-level wage data come from the Bureau of Labor Statistics Occupational Employment Statistics.

HSA measures were constructed by first measuring HMO enrollment, ARF characteristics, and wage data at the county level. The ARF provided county-level measures of the number of primary care physicians, median per-capita income, unemployment rate, population of the HSA, and percent of the population over 65 years of age. Information on the size distribution of employers comes from the Census's County Business Patterns. County data were then aggregated into HSAs using a crosswalk between counties and HSAs. The HSA-level measures were constructed as weighted averages of all counties in the HSA, with the weights being the proportions of the county's

Table 1: Summary Statistics (Unweighted) (Standard Deviations in Parentheses)

Variable	*1990*	*2000*	*Δ or %Δ*
Dependent variables			
HHI (beds)	0.2821 (0.15)	0.3491 (0.17)	0.0623 (0.099)
HHI (inpatient)	0.3173 (0.18)	0.3827 (0.19)	0.0617 (0.11)
Merger HHI (base = 1990)	0.2821 (0.15)	0.3392 (0.17)	0.0533 (0.093)
Strong HHI (beds)	0.2653 (0.14)	0.2893 (0.16)	0.020 (0.074)
Other explanatory variables			
HMO penetration	6.2 (7.1)	19.3 (14.8)	12.9 (11.0)
Percent elderly	12.9 (2.8)	13.0 (2.7)	− 0.08% (0.75)
Population	521,575 (854,179)	603,632 (967,455)	11.1% (10.0%)
Median per capita income	$16,544 ($3,277)	$25,123 ($5,408)	13.4% (6.3%)
Percent population in poverty	14.2 (5.70%)	12.8 (4.86%)	− 1.37 (1.66%)
Beds per 1,000 population		6.02 (2.11)	
Percent FP hospital in 1990		12.4 (17.6%)	
Hospital CON regulation in 1990		55.5 (49.8)	
Instruments			
Primary care physicians per 1,000 in 1990		0.28 (0.084)	
Number of establishments with one employee		53.0 (3.3)	
Number of establishments with five to nine employees in 2000		20.3 (1.3)	
Number of establishments with 50–99 employees in 2000		2.8 (0.53)	
Number of establishments with more than 99 employees in 2000		1.6 (0.40)	
N		444	

HHI, Herfindahl–Hirschman index; HMO, health maintenance organization; FP, for profit; CON, certificate of need.

population in the HSA. State-level, hospital certificate of need (CON) regulations are from the American Health Planning Association.

Our primary sample is HSAs with a population of more than 100,000 and more than one hospital in 1990. We dropped the monopoly HSAs as those areas, by definition, cannot experience a horizontal consolidation (unless there is entry and then merger/system formation—a very unlikely possibility).[14] We also present results using a population threshold of 500,000.

Table 1 lists the dependent and explanatory variables as well as the instruments in the analysis and the unweighted means and standard deviations of these variables. The right-hand side variables were selected because they plausibly affect hospital profitability either through the interactions of

Table 2: Long-Differenced, OLS Estimates of the Impact of HMO Penetration on Change in Hospital HHI (Standard Errors in Parentheses)

	Dependent Variable and Sample				
Variable	*ΔHHI (Beds) Population > 100,000 (1)*	*ΔHHI (Beds) Population > 100,000 (2)*	*ΔHHI (Days) Population > 100,000 (3)*	*ΔHHI (Beds) Population > 500,000 (4)*	*ΔHHI (Beds) Population > 100,000 (5)*
ΔHMO penetration	− 0.054 (0.049)	—	− 0.090 (0.055)	− 0.014 (0.069)	—
ΔHMO penetration$_{t-2}$		0.0030 (0.052)	—		
HMO penetration in 1990	0.023 (0.12)	—	− 0.0081 (0.13)	− 0.16 (0.10)	—
Δ Logarithm of number of HMO	—	—	—	—	− 0.0040 (0.0096)
Number of entrants	− 0.013 (0.013)	− 0.013 (0.013)	− 0.017 (0.012)	− 0.030 (0.021)	− 0.013 (0.013)
Number of exits	0.0068 (0.0029)	0.0068* (0.0029)	0.0055 (0.0028)	0.0048 (0.0026)	0.0070* (0.0029)
Beds per 1,000 population in 1990	0.0026 (0.0029)	0.0025 (0.0029)	0.0028 (0.0031)	− 0.0026 (0.0049)	0.0025 (0.0030)
N	444	444	444	115	444
p-value of *F*-test of joint significance of HMO variables	.53	—	.27	.28	—
R^2	0.045	0.042	0.050	0.17	0.043

Note: The following control variables are included in the regression but not reported: percent elderly in 1990, change in the percent elderly, logarithm of per capita income in 1990, logarithm of change in the per capita income, unemployment rate in 1990, change in the unemployment rate, percent poverty in 1990, change in the percent poverty, logarithm of the change in population, CON indicator in 1990, percent FP hospital in 1990, and log of the HSA land area.

*Significant at 5% level of confidence.

OLS, ordinary least squares; HMO, health maintenance organization; HHI, Herfindahl–Hirschman index; CON, certificate of need; FP, for profit; HSA, Health Service Area.

supply and demand or through regulatory interventions. There is a large increase in hospital concentration and HMO penetration during the 1990s. Approximately 40 percent of all HSAs experienced a horizontal hospital merger. There are also large declines in inpatient days per capita (20 percent) and the number of beds per capita (17 percent). In ancillary analysis we performed, the decline in inpatient days and beds per capita appears unrelated to HMO penetration.[15]

RESULTS

Table 2 presents the parameter estimates from our primary specifications. Column (1) presents the results from our base specification. The coefficient on the change in HMO penetration is negative and not significantly different from zero and the coefficient on the 1990 HMO penetration is positive, small, and also insignificantly different from zero. Column (2) presents the coefficients estimates with lagged change in HMO penetration as the right-hand side variable of interest. The coefficient on HMO penetration is small in magnitude and insignificant.

Table 2, column (3) presents the results with inpatient days used to measure HHI. The coefficient on the change in HMO penetration is negative and significantly different from zero at the 5 percent level of confidence, while the coefficient on the 1990 HMO penetration is negative and insignificantly different from zero. In column (4) we present the coefficient estimates when we increase the HSA population threshold to 500,000. The coefficients on both HMO penetration variables are negative and insignificant. The joint test of both the coefficient on HMO penetration variables in all specifications fails to reject the null hypothesis that they are different from zero. The last column of Table 2 presents the results using the change in the logarithm of the number of HMOs in the HSA as the independent variable. The coefficient is negative and insignificant. The results in Table 2 do not suggest that the rise of managed care caused hospital consolidation.

Table 3 presents the results using the change in Strong HHI and the ΔMHHI as dependent variables for the two different population threshold samples. Broadly consistent with the estimates in Table 2, none of the HMO penetration variables is significantly different from zero at traditional levels of confidence in any specification.

Table 3: Estimates of the Impact of HMO Penetration on Change in Hospital Merger HHI (Standard Errors in Parentheses)

	ΔMerger HHI		*ΔHHI (Beds) Strong Ownership Definition*	
Variable	*Population > 100,000 (1)*	*Population > 500,000 (2)*	*Population > 100,000 (3)*	*Population > 500,000 (4)*
ΔHMO penetration	0.051 (0.042)	0.055 (0.051)	− 0.051 (0.042)	− 0.035 (0.052)
HMO penetration in 1990	0.15 (0.098)	− 0.12 (0.092)	− 0.023 (0.080)	− 0.041 (0.067)
Number of entrants	—	—	− 0.037** (0.0084)	− 0.048** (0.013)
Number of exits	—	—	0.0070** (0.0026)	0.0024 (0.0014)
Beds per 1,000 population in 1990	0.0021 (0.0083)	0.0033 (0.0057)	− 0.0011 (0.0026)	− 0.0029 (0.0030)
N	444	115	444	115
p-value of *F*-test of joint significance of HMO variables	.32	.16	.48	.72
R^2	0.051	0.13	0.085	0.30

Note: The following control variables are included in the regression but not reported: percent elderly in 1990, change in the percent elderly, logarithm of per capita income in 1990, logarithm of change in the per capita income, unemployment rate in 1990, change in the unemployment rate, percent poverty in 1990, change in the percent poverty, logarithm of the change in population, CON indicator in 1990, percent FP hospital in 1990, and log of the HSA land area.

**Significant at 1% level of confidence.

HMO, health maintenance organization; HHI, Herfindahl–Hirschman index; CON, certificate of need; FP, for profit; HSA, Health Service Area.

Table 4: IV Estimates of the Impact of HMO Penetration (Standard Errors in Parentheses)

	Dependent Variable			
Variable	*ΔHHI (Beds) Population > 100,000 (1)*	*ΔHHI (Patients) Population > 100,000 (2)*	*ΔMerger HHI Population > 100,000 (3)*	*ΔHHI (Beds) Strong Population > 100,000 (4)*
ΔHMO penetration	−0.023 (.32)	−0.16 (.31)	−0.19 (.24)	0.22 (.22)
1990 HMO penetration	0.36 (.50)	0.21 (.41)	−0.024 (.32)	0.0028 (.32)
Over identification restrictions test ($\chi^{2(4)}$) (*p*-value)	3.24 (.20)	8.08 (.09)	13.55 (.01)	13.26 (.01)
	First Stage Estimates			
		Δ HMO Penetration		*1990 HMO Penetration*
Primary care physicians per 1,000 in 1990		0.11 (0.068)		0.049 (0.041)
Percent of establishments with one employee in 1990		−2.03 (2.59)		−0.69** (0.21)
Percent of establishments with five to nine employees in 1990		−3.29 (2.61)		−0.67 (0.41)
Percent of establishments with 50 or more employees in 1990		−1.56 (3.79)		−2.69** (0.79)
Partial R^2		0.025		0.021
F		2.63		4.50
(*p*-value)		(.03)		(.0001)

Note: The following control variables are included in the regression but not reported: percent elderly in 1990, change in the percent elderly, logarithm of per capita income in 1990, logarithm of change in the per capita income, unemployment rate in 1990, change in the unemployment rate, percent poverty in 1990, change in the percent poverty, logarithm of the change in population, CON indicator in 1990, percent FP hospital in 1990, and log of the HSA land area.

**Significant at 1% level of confidence.

IV, instrumental variable; HMO, health maintenance organization; HHI, Herfindahl–Hirschman index; CON, certificate of need; FP, for profit; HSA, Health Service Area.

Table 4 presents the IV estimates (both the first and second stages) of the HMO penetration coefficients on our four different HHI measures. Again, none of the HMO penetration coefficients are significant at traditional levels of confidence. However, some of the coefficients are large, albeit imprecisely estimated.

The only other coefficient on our control variables that is consistently significant across specifications is the 1990 population. Larger initial populations are associated with smaller changes in concentration. Given that population is correlated with the number of hospitals in a location and that HHI is a nonlinear function of the number of hospitals, this correlation is not surprising. However, it is noteworthy that the obvious explanatory variables to not explain cross-sectional differences in the change in hospital concentration. It remains a puzzle why some locations became more concentrated while in other areas the hospitals did not consolidate.[16]

Explaining the Difference between Our Estimates and DSW

There are several possible reasons why our results differ from DSW. First, we difference both our left-hand and right-hand variables of interest while DSW do not difference their measure of HMO penetration. Second, DSW use a more inclusive measure of managed care but one that may have more measurement error. Third, they examine a different time frame, 1981–1994. Fourth, they use the MSA as the unit of analysis. Fifth, they limit their analysis to the largest 62 MSAs with population over 800,000 and no significant HMO penetration in the early 1980s.

In order to determine the source of our differing conclusions we attempt to replicate their results with our data. We use the largest 62 MSAs and data from 1985 to 1994 and we exclude the MSAs DSW identify has having significant HMO penetration in the early 1980s. We use a very similar, but not identical, set of control variables and instruments.[17]

Table 5 presents the results of our attempts to replicate DSW. In column (1) we present the coefficient estimates of this effort. As in DSW, the coefficient on managed care penetration is positive and significant.[18] In column (2) we estimate the same equation but replace the level of managed care penetration with the change in the managed care penetration. The coefficient on the managed care variable declines and becomes insignificant.

In columns (3) and (4) of Table 5 we estimate the parameters as in columns (1) and (2) on the same sample, but using OLS. The para-

Table 5: Replication of Dranove, Simon, and White (2002)—Estimating the impact of HMO Penetration on Hospital Concentration

	Dependent Variable Is ΔHHI							
	IV Estimation, MSA Population > 800,000 1985–1994		*OLS Estimation, MSA Population > 800,000 1985–1994*		*IV Estimation, MSA Population > 800,000 1985–1994 Dependent Variable Is ΔHHI measured using bed size*		*OLS Estimation, MSA Population > 500,000 1985-1994*	
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*
HMO penetration	0.21* (0.11)	—	0.13** (0.034)	—	0.077 (0.048)	—	0.13** (0.037)	—
ΔHMO penetration	—	0.085 (0.12)	—	0.096* (0.046)	—	−0.010 (0.059)	—	0.076 (0.044)
1992 log population	0.020 (0.013)	0.023* (0.013)	0.00085 (0.016)	0.022* (0.011)	0.0082 (0.0056)	0.0096 (0.0059)	0.033 (0.011)	0.035 (0.013)
ΔLog per capita income	0.13 (0.14)	0.081 (0.14)	−0.070 (0.12)	0.087 (0.14)	0.13 (0.068)	0.097 (0.066)	0.049 (0.12)	0.090 (0.13)
ΔLog population	−0.14 (0.092)	−0.15 (0.094)	−0.15 (0.14)	−0.14 (0.069)	−0.019 (0.030)	−0.027 (0.033)	−0.17* (0.074)	−0.17* (0.075)
ΔPercent elderly	−0.0032 (0.081)	−0.048 (0.079)	0.012 (0.045)	−0.046 (0.061)	−0.043 (0.036)	−0.065 (0.028)	−0.085 (0.054)	−0.095 (0.055)
ΔPopulation density	0.000011 (0.000022)	0.000043 (0.00022)	0.000047 (0.00014)	0.00043 (0.00014)	0.000023 (0.000090)	−0.000016 (0.00011)	−0.0000066 (0.00014)	0.0000054 (0.00014)
N	62	62	62	62	62	62	92	92
1st stage *F* (*p*-value)	1.32 (.24)	2.24 (.021)	$R^2 = .19$	$R^2 = .15$	1.18 (.32)	2.52 (.0086)	$R^2 = .19$	$R^2 = .15$
Over-identification restriction *p*-value	.29	.23	—	—	.42	.35	—	—

*Significant at 5% level of confidence.

**Significant at 1% level of confidence.

HMO, health maintenance organization; HHI, Herfindahl–Hirschman index; IV, instrumental variable; MSA, metropolitan statistical area; OLS, ordinary least squares.

meter estimates in column (3) is smaller than the estimates in column (1) but it is still significant. However, the OLS estimates of the impact of the differenced managed care variables are positive and significant. In columns (5) and (6) we replicate the analysis in columns (1) and (2) using a HHI that is based on bed size. The coefficients on both HMO penetration measures are insignificant. In the last two columns of Table 5, we estimate the same specification as in columns (3) and (4) but use a more inclusive sample selection rule. We include all MSAs with a population greater than 500,000. Both coefficients on managed care population are insignificant in this sample.

Our estimates suggest that the results in DSW are sensitive to the decisions not to difference the managed care variable, the measure of hospital size, the sample selection criteria, and the time period they studied. While these findings are very suggestive, they are not conclusive because the data we use are not identical to DSW.

CONCLUSIONS

It is widely believed that the rise of managed care caused the hospital consolidation wave of the 1990s. In this study we test this proposition using data on managed care penetration and hospital consolidation from 1990 to 2000. Our results suggest that the common wisdom is false—managed care penetration is not significantly related to hospital consolidation. This finding is robust to different specifications, time frames, and sample selection criteria. Furthermore, our analysis does not find other correlates of hospital consolidation leaving the question of what caused the hospital merger wave an open one.

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NOTES

1. A HHI of 0 is perfect competition and 1 is pure monopoly.
2. The unweighted HHI is 0.41 in 1990 and 0.47 in 2000.

3. For example, Evans, Cuellar, and Gertler (2005) say, "Hospital consolidation is likely a response to managed care" (p. 214). Also, see Dranove, Simon, and White (2002), Employee Benefit Research Institute (1999), Czajkowski (1999), Grembowski et al. (2002), McCue, Clement, and Luke (1999) and Hollis (1997).
4. Our measure of hospital concentration includes direct ownership of hospital assets as well as membership in a hospital system.
5. While managed care may reduce demand, the advancement of medicine has surely had a larger effect on the demand for inpatient days. According to our estimates, from 1990 to 2000 average inpatient days per capita declined by 54 percent.
6. It is also likely that antitrust markets are much smaller than the large MSAs and thus they likely have significant measurement error.
7. For example, Baker and Brown (1999) use HMO penetration data from Group Health Association of America as a measure of managed care penetration.
8. It is likely that expectations about future HMO penetration affect contemporaneous merger decisions. Our specification is consistent with this if expectations are based on contemporaneous HMO penetration. In so far as other information is used to formulate expectations, this information is embedded in α_i. If contemporaneous HMO penetration is not relevant in the formulation of expectations regarding future HMO penetration, then our empirical approach will not capture this phenomena.
9. We have performed our analysis on both a longer period, 1985–2000, and a shorter period, 1992–1998. The results from those analyses are qualitatively identical to those we present here. These results are available from the authors upon request.
10. Results are available from the authors upon request.
11. The *F*-test suggests that the small sample bias will be less than 0.30. The presence of this bias will not overturn any of our conclusions.
12. A literature in antitrust analysis suggests that using patient flows to define markets can be misleading (Werden 1990; Capps et al. 2002). However, it is probably the case that using patient flow data to identify markets is more accurate than using existing geopolitical boundaries.
13. We thank Marty Gaynor and colleagues for providing us with this data.
14. In order to check the robustness of our findings, we have also performed the analysis limiting the sample to those HSAs with less than 11 hospitals. Again, the qualitative results using this sample are identical to those we present here. These results are available from the authors upon request.
15. These results are available from the authors upon request.
16. Burns and Pauly (2002) argue that hospital consolidation during this period is driven by consultants and thus cross-sectional variation in consolidation is the consequence of differences in the influence of consultants across locations. In so far as we find no other meaningful correlates of consolidation, our results are consistent with this hypothesis.
17. DSW use the percent of workforce self-employed and percentage of workforce employed in large firms in 1992 as instruments. We use the percentage of firms in each size category in 1992 and 1985 as instruments.
18. The *F*-statistics on the first stage regression are smaller than in DSW.

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