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I. Introduction

In the 1990s the US hospital industry consolidated. Figure 1 displays the mean population-weighted hospital Herfindahl-Hirschman Index (HHI) and the number of horizontal mergers, acquisitions and hospital system expansions for Metropolitan Statistical Areas (MSAs). The average HHI increased from .1888 in 1990 to .2772 in 2003, with the vast majority of the increase due to hospital consolidation. On average there were 58 hospital mergers within MSAs in any given year with the peak of the wave occurring in 1996 when there were 108 consolidations.[1]

This paper estimates the impact of hospital consolidation on welfare. For the purposes of quantifying the price impact of consolidations on the under-65 population, hospitals are modeled as an input to the production of health insurance. In order to better understand the roles of upstream and downstream market structures in determining the impact of upstream horizontal mergers, we also make a modest contribution to the theory of mergers in industries that are inputs to the final consumption good.

We examine hospital consolidations for several reasons. First, over the decade of the 1990s a wave of consolidation occurred but this wave was not uniform across hospital markets. In approximately 45% of the MSAs there was no change in market structure due to consolidation. Furthermore, in those markets in which a consolidation took place there is substantial variation in the change in market structure. Thus, the hospital industry provides a nice case study of the impact of horizontal mergers because we observe many markets with varying amounts of consolidation.

[1] We use the term "consolidation" to refer to all combinations of previously independent organizations, e.g. mergers, acquisitions, consolidations and hospital system expansions. For stylistic reasons we sometimes use the term "merger" to refer to the same set of combinations.

Second, understanding competition in the hospital industry is important in its own right. Inpatient hospital care comprises 31% of total US health care expenditures (Smith et al., 2005). Furthermore, hospitals are the second largest 3-digit North American Industry Classification System (NAICS) industry in the US with over $509 billion in annual revenue in 2002 or 4.9% of Gross Domestic Product (NAICS Code 622, US Census Bureau, 2004).[2] Thus, merger activity in the hospital industry not only provides an opportunity to test theory, but also may exert a substantial impact on aggregate economic activity.

Our model predicts that horizontal mergers in upstream markets will have larger consequences for consumer prices, hence welfare, the more competitive the downstream market. That is, the fewer competitors downstream the more an upstream merger simply transfers monopoly rents from the downstream firms to the upstream firms.

The hypothesis that the welfare consequences of upstream mergers are a function of downstream competition is supported by our empirical analysis. Hospital mergers led to an increase in HMO premiums for those HMOs that operated in the most competitive markets. However, on average, we find no effects of hospital mergers on premiums for HMOs that operate in markets with few competitors. Our estimates indicate that the aggregate impact of hospital mergers is modest but not trivial. In 2001, average HMO premiums are estimated to be 3.2% higher than they would have been absent any hospital merger activity during the 1990s. In relatively competitive HMO markets, premiums are 5.3% higher than they would have been with no merger activity.

Our most important finding is that these premium increases have consequences for the quantity and source of health insurance acquired by the under-65 year old

[2] The largest 3-digit industry is 'motor vehicles parts and dealers' with $804 billion in revenues.

population. We match MSA-level merger information to the Current Population Survey (CPS) from 1990 to 2003 to analyze the impact of hospital mergers on insurance status. We find that hospital mergers in MSAs with relatively competitive HMO markets led to decreases in private health insurance and increases in the population without health insurance. However, in markets with weak HMO competition, hospital mergers did not appear to affect the amount of private health insurance coverage or the number of the uninsured. Hospital mergers in such markets appear to transfer rents from HMOs to hospitals.

The estimated impacts of hospital mergers on private health insurance take-up and the uninsured population are also modest but not trivial. In 2003, we estimate that because of hospital mergers the likelihood of having private insurance declined by approximately .46 percentage points, reducing private health insurance rolls by 695,000 lives. From 1990 to 2003, we estimate that hospital mergers resulted in a decline in private health insurance of 5.8 million life years.

Our estimates indicate that the vast majority of those who exited private insurance joined the ranks of the uninsured. In our sample of CPS data, in 2003 the rate of uninsurance among 22 to 62 years olds was .178. We estimate that hospital mergers since 1990 led to an increase in the 2003 uninsurance rate of approximately .43 percentage points. This translates into an extra 650,000 individuals lacking health insurance because of hospital consolidations that occurred over the previous 14 years. From 1990 to 2003, we estimate that hospital mergers increased the uninsured population by 5.5 million life-years.

We use our estimates of changes in premiums and insurance take-up to calculate rough estimates of consumer surplus loss for adults due to hospital mergers. Between 1990 and 2001, our estimates imply that hospital mergers resulted in a loss of consumer surplus of over $42.2 billion. In 2001, consumers lost over $7.3 billion surplus or approximately $50 per capita. While the loss of consumer surplus is substantial, the total welfare loss due to hospital consolidation over this period is estimated to be a modest $95.4 million. The reason for the much smaller dead weight loss is that, consistent with the previous literature, our estimates imply that the demand for health insurance is inelastic, the premium increase is modest and the "revenue base" for the premium increase (i.e. the size of the population with health insurance) is quite large.

To the best of our knowledge, this is one of the few papers that have estimated the welfare consequences of horizontal mergers for consumers. There is a modest literature examining the effects of consummated mergers on prices, but few papers have documented quantity (or quality) consequences of mergers which are necessary to assess welfare effects. Antitrust laws have existed for over 110 years, yet there is surprisingly little empirical evidence on the consequences of mergers that can be used to hone competition policy.[3]

The next section briefly summarizes the theoretical and empirical literatures on mergers. Section III presents a very simple model of the consequence of upstream mergers. Section IV discusses the empirical framework and Section V describes the data. Section VI presents estimation results and Section VII concludes.

[3]As Gurrea and Owen (2003) state: "The sad truth is that despite endless calls for empirical study of the effects of mergers and of antitrust enforcement of section 7, there is very little empirical evidence demonstrating the effects of mergers (or enjoining mergers) on consumer welfare."

II. Literature

A. Theoretical Literature

At least since the passage of the Sherman Act in 1890, many economists and public policy makers have suspected that market power can have deleterious effects on markets and that mergers are one mechanism by which firms can achieve market power. Marshall (1920) provided an early formalized basis for this belief. However, Stigler (1950) noted that while mergers may increase market power, the incentives for firms to consolidate are mitigated by the presence of an externality. In a symmetric equilibrium, all non-merging firms in the market gain more from a merger than the merging parties. In a paper that has significantly impacted antitrust thought, Williamson (1968) showed that mergers that generate efficiencies, even if they create substantial market power, can be welfare enhancing.

In more recent analysis, Salant, Switzer and Reynolds (1983) formalize the ideas of Stigler and show in a simple Cournot model that unless there are efficiencies or that firms achieve duopoly market power, a merger will not be privately profitable. McAfee and Williams (1992) Deneckere and Davidson (1985) Perry and Porter (1985) and Farrell and Sharpiro (1990) all model the welfare consequences of privately profitable mergers in a static framework. A synthesis of the results from these papers is that privately profitable mergers can either decrease or increase welfare. Gowrisankaran (1999) models endogenous mergers in a dynamic framework with firm entry and exit, and he shows that antitrust enforcement can enhance welfare. That is, the result that mergers can reduce welfare is robust to dynamic considerations.

B. Empirical Literature

While the theoretical literature is relatively rich and there is a very large empirical literature measuring the relationship between market concentration and prices, there are relatively few studies of the realized consequences of actual mergers on prices and quantities. This literature focuses primarily, but not exclusively, on three industries: airlines, banking, and hospitals. Borenstein (1990); Werden, Joskow, and Johnson (1991) and Kim and Singal (1993) all find that airline mergers in the 1980s led to price increases. Prager and Hannan (1998) find that the deposit rates offered by banks operating in markets in which substantial horizontal consolidation occurred fell less than for banks operating in markets in which consolidation did not occur. Berger, et al. (1998) estimates that bank mergers led to a decline in small business lending by the merging institutions, which was offset as competing banks increasing their lending over time. Focarelli and Panetta (2003) find that Italian bank mergers initially caused consumer welfare to decline but over time the merging firms were able to achieve efficiencies that led to a long run increase in welfare. Using structural methods, Pesendorfer (2003) estimates the welfare impact of the wave of mergers in the paper industry during the mid-1980s. He finds these mergers led to both static and dynamic efficiencies that yielded significant consumer and producer surplus gains.

In sum, the empirical literature estimating the impact of mergers on prices and quantities from non-hospital industries suggests that they often lead to price increases. However, the works of Focarelli and Panetta (2003) and Pessendorfer (2003) are an important caveat to this conclusion—mergers can lead to efficiencies that benefit both consumers and producers. This work highlights (and expands) the empirical relevance of the theoretical point Williamson (1968) made 35 years earlier. Next, we turn our attention to the hospital competition literature.

Since the 1980s a large literature has evolved devoted to the impact of hospital competition on inpatient prices paid by insurers. Several papers have examined the impact of mergers on prices while a larger literature uses the cross sectional variation in market structure to identify the impact of competition on prices. More recently, researchers have estimated structural models and simulated the impact of hospital mergers on price. We briefly review this literature below.

Several papers have used a pre/post research design to assess the impact of hospital mergers on hospital costs and the price of inpatient care paid by insurers. The typical finding is that mergers appear to reduce costs. Using data from 1986 to 1994, Connor, et al. (1997) find that hospital mergers decrease expenditures and revenues per admission by 4%. They interpret their results as implying that hospital mergers achieve significant efficiencies. Consistent with this result, Dranove and Lindrooth (2004) find that mergers where hospitals combine financial statements result in significant cost reductions. Using a very limited sample of hospital mergers, Capps and Dranove (2003) find that hospital consolidations led to increases in hospital prices that are greater than the median increase in hospital prices. Vita and Sacher (2001) analyze the impact of the Dominican Santa Cruz Hospital’s acquisition of its sole competitor in Santa Cruz, CA, AMI-Community Hospital and find that the merger led to price increases of roughly 15%. More recently, in an analysis that corrects for the endogeneity of mergers, Dafny (2005) finds that hospitals that are located within 7 miles of a merging rival raise prices by 40% post-merger. Finally, relying on interviews of health care executives and policymakers, Devers et al. (2003) argue that hospital negotiating leverage with health insurers increased substantially from 1996 to 2000 and that hospital consolidation was a prime contributor to the increase in hospital bargaining power.

Two papers employ structural approaches to estimate the impact of hospital mergers on price. Using different estimating strategies, Gaynor and Vogt (2003) and Capps, Dranove and Satterthwaite (2003) find that hospital mergers in an urban setting can lead to significant price increases. Gaynor and Vogt (2003) simulate a merger in San Louis Obispo County that would create a monopoly and estimate that such a transaction would increase price by 53%. Capps, Dranove and Satterthwaite (2003) simulated a merger between two hospitals in La Jolla, CA and predicted that it would lead to a 6% price increase.

Research on the relationship between hospital concentration and prices generally finds that an increase in hospital concentration is correlated with higher prices for inpatient care, and many interpret this correlation as a causal relationship. This literature primarily relies on cross-sectional variation in hospital concentration to identify the relationship between concentration and the price paid by insurers. The source of identification in this approach has been criticized, but nevertheless this body of work provides much of the evidence on the impact of hospital competition. Comprehensive reviews of this literature can be found in Dranove and Satterthwaite (2000) and Gaynor and Vogt (2000). According to Gaynor and Vogt (2000), the estimates from this literature imply that an increase in the HHI from .20 to .28 will lead to price changes that range between -3% and 17% with the average (unweighted) price increase across the estimates of roughly 4%.

In sum, the empirical literature suggests that hospital mergers in concentrated markets can lead to price increases for inpatient care. However, the estimated magnitudes of these price increases vary considerably. To the best of our knowledge, no attempt has been made to measure the impact of hospital mergers on the welfare of the final consumer.[4]

III. A Simple Theory of the Effect of Upstream Mergers

The literature studying the impact of non-vertical, upstream mergers on downstream markets is sparse.[5] Given the lack of analytical results to draw upon, the purpose of this section is to build some theoretical guidance for our empirical specification. We posit the simplest model that can highlight the relationships between market structures and prices in two linked markets. We make many assumptions forsaking realism for simplicity. Specifically, we do not model that HMOs often selectively contract with hospitals and that HMOs and hospitals engage in bargaining relationships.[6] We assume that the demand for HMO coverage is linear and the production technology for an HMO uses two inputs in fixed proportions (that is, in order to sell a policy an HMO must use both physician and hospital inputs in fixed proportions); and we assume both hospital services and HMO coverage are homogeneous goods.

We assume that there are N downstream HMOs and M upstream hospitals. The market for physician services is treated as perfectly competitive and thus price is set at

[4] Several papers have examined the impact of changes in hospital concentration on the quality of care. For example, see Kessler and McClellan (2000).
[5] Two works that are relevant are Inderst and Wey (2003) and Blair and Harrison (1993).
[6] Ho (2006) models the formation of HMO hospital networks.

marginal cost. Both HMOs and hospitals are Cournot competitors, choosing output while taking the output choices of their competitors as given.

The market demand for HMO services is given by $P_{HMO} = A - bQ_{HMO}$ where P_{HMO} is the price of HMO services and Q_{HMO} is the market quantity of HMO services purchased. The cost function for a given HMO is $C(q_i) = q_i\left(\frac{w}{\alpha} + \frac{f}{\beta}\right)$ where w is the price of a hospital day (which is endogenous in our model), f is the price of a physician visit, and α, β are production function parameters. The HMO takes the prices of hospital and physician services as given. That is, there is no bargaining between the upstream and downstream firms.

The HMO objective function is simply:

(1) $$\mathrm{Max}_{q_i}\ P(Q)q_i - C(q_i)$$

The first order conditions are:

(2) $$A - bQ - bq_i = \left(\frac{w}{\alpha} + \frac{f}{\beta}\right)$$

Assuming HMOs are identical and a symmetric equilibrium implies that a HMO's supply function and the aggregate supply function are given by:

(3) $$q_i = \frac{1}{b(N+1)}\left(A - \frac{w}{\alpha} - \frac{f}{\beta}\right)$$

and

(4) $$Q_i = \frac{N}{b(N+1)}\left(A - \frac{w}{\alpha} - \frac{f}{\beta}\right).$$

The equilibrium HMO price is then:

(5) $$P_{HMO} = A - \frac{N}{(N+1)}\left(A - \frac{w}{\alpha} - \frac{f}{\beta}\right)$$

From the equilibrium HMO supply function we can derive the aggregate derived demand for hospital days, *H*, as:

(6) $$H = \frac{N}{\alpha b(N+1)}\left(A - \frac{w}{\alpha} - \frac{f}{\beta} \right).$$

The inverse demand for hospital days is simply:

(7) $$w = \alpha\left(A - \frac{\alpha b(N+1)}{N} H - \frac{f}{\beta} \right).$$

Turning to the upstream market, hospitals take the derived demand (7) as the market demand for their output. The hospital's objective function is:

(8) $$\mathrm{Max}_{h_i}\ w(H)h_i - C(h_i)$$

The first-order conditions, after substituting in the derived demand, are:

(9) $$\alpha\left(A - \frac{\alpha b(N+1)}{N} H - \frac{f}{\beta} \right) - \frac{\alpha^2 b(N+1)}{N} h_i = mc_h\ .$$

Assuming a symmetric Nash equilibrium gives the individual and market supply curves for hospital services:

(10) $$h_i = \left(\frac{N}{(M+\alpha)(N+1)b} \right)\left(A - \frac{mc_h}{\alpha} - \frac{f}{\beta} \right)$$

and

(11) $$H = \left(\frac{NM}{(M+\alpha)(N+1)b} \right)\left(A - \frac{mc_h}{\alpha} - \frac{f}{\beta} \right)$$

Substitution into market derived demand yields:

(12) $$w = \alpha\left(A - \alpha\left(\frac{M}{(M+\alpha)}\left(A - \frac{mc}{\alpha} - \frac{f}{\beta} \right) \right) - \frac{f}{\beta} \right)$$

Substituting back into the HMO inverse demand gives the HMO price as a function of the HMO and hospital market structure:

$$(13) \qquad P_{HMO} = A - \frac{N}{(N+1)}\left(\frac{\alpha M}{(M+\alpha)}\left(A - \frac{mc}{\alpha} - \frac{f}{\beta}\right)\right)$$

The downstream equilibrium price is a function of the product of the upstream and downstream market structures. In this framework, the impact of a hospital merger on HMO prices and thus welfare depends not only on the hospital market structure but on the HMO market structure as well. Specifically,

$$(14) \qquad \left.\frac{\Delta P_{HMO}}{\Delta M}\right|_{\Delta M=-1} = \frac{N}{(N+1)}\left(\left(\frac{\alpha^2}{(M+\alpha)(M-1+\alpha)}\right)\left(A - \frac{mc}{\alpha} - \frac{f}{\beta}\right)\right).$$

Given our assumptions, as the HMO market becomes more competitive, the impact of a given hospital consolidation on HMO prices increases.[7] That is, while total welfare will be lower when the HMO market is more consolidated (there is double marginalization), the change in welfare from the marginal merger will be lower when the HMO market is more concentrated. This is the key insight from this highly stylized theory that we use to guide the data analysis. The impact of hospital mergers on welfare is a function of the interaction of HMO and hospital market structure.

IV. Empirical Framework

We are interested in estimating the impact of hospital mergers on HMO premiums and the quantity of health insurance purchased. We use two units of analysis. First, the

[7] This result is sensitive to the assumptions about the functional form of demand. In a constant elasticity of demand framework, as the HMO market becomes more competitive, the impact of a given hospital consolidation on HMO prices *decreases*. However, as we discuss below, the implication of the model using a linear demand framework is the one that turns out to be empirically relevant.

impact of hospital mergers on HMO premiums is examined with the HMO as the unit of analysis. Second, the impact of hospital mergers on health insurance purchase is examined with the Primary Metropolitan Statistical Area (PMSA) or Metropolitan Statistical Area (MSA) as the unit of analysis.[8] The primary data source for hospital consolidations is the American Hospital Association (AHA). Information on consolidations is merged with HMO level data for the first analysis and the Current Population Survey (CPS) data at the MSA level for the second analysis.

A. HMO Premiums

To investigate the impact of hospital consolidations on HMO premiums we estimate parameters from the following HMO-level regression:

$$(15) \qquad \log p_{jt} = \mu_j + \alpha_1 \log MergerHHI_{jt} + \alpha_2 \log NHMO_{jt} + \beta X_{jt} + \sum_{t=1991}^{2001} \phi_t year_t + \varepsilon_{jt}$$

where p_{ij} is the average premium charged by HMO *j* across all of the markets it participates in period *t*, $MergerHHI_{jt}$ is the enrollment-weighted average hospital "merger" Herfindahl-Hirschman Index. We discuss the "merger" component of the construction of this variable below. $NHMO_{ij}$ is the population-weighted average number of HMOs operating in the Health Services Area (HSA) over all the counties served by the HMO, X_{jt} are variables that measure the characteristics of the HMO that may impact its costs and product quality and average characteristics of the markets it serves that may impact its costs and/or the market demand. The variable $year_t$ is an annual dummy variable—our HMO data span the period 1990 to 2001. The HMO-specific error term, μ_j may be correlated with the right hand side variables and in particular $MergerHHI_{jt}$

[8] We refer to PMSA and MSAs generically as MSAs.

and $NHMO_{ij}$. Since some unobserved characteristics of HMO pricing behavior may be correlated with their propensity to experience hospital mergers or the amount of direct competition they face, we estimate the parameters of (15) using a standard fixed-effects estimator. To calculate consistent standard errors in the presence of auto-correlated residuals we bootstrap the estimates.

We use HMOs as the downstream seller of health insurance and the number of HMOs as the measure of health insurance market structure; however, there are a number of possible measures of health insurance and of market structure, so our choices deserve justification. We focus on HMOs as opposed to all possible forms of health insurance because information on HMOs is available at the MSA level while information on the number of other types of insurers is available only at the state level. The lack of data on other forms of health insurers should not affect our results. Through the use of selective contracting HMOs are the health insurance organizational form that generates the greatest hospital price sensitivity — the rise of HMOs is credited with introducing price competition into the market for hospital services (Gaynor and Vogt, 2000). Thus, the number of HMOs (or some other indicator of HMO market structure) is likely a better measure of the degree of price competition hospitals face than the total number of health insurers.

We measure HMO market structure using the number of independent organizations as opposed to a HHI index as we can count this with little error. Calculating a HHI requires assumptions regarding the distribution of enrollees over a HMO's service area and likely can only be measured with non-trivial error.[9]

The theory outlined above suggests that the impact of a change in the number of hospitals on HMO prices will be a function of HMO market structure. To capture this possibility we split the data in three different samples based on the 1995 mean value of $NHMO_{ij}$. The cut-offs are chosen so that they roughly correspond to thirds of the CPS data sample. The samples are zero to six HMOs, seven to nine HMOs, and ten or greater HMOs. The theory of the previous section suggests that in the most competitive HMO markets, the coefficient on $MergerHHI_{jt}$ should be positive—an increase in hospital market concentration should increase HMO premiums in those markets.

B. Health Insurance

We estimate the impact of mergers on the probability than an individual will have private and any health insurance a using a linear probability model. Letting I_{imt} denote the insurance status indicator for individual *i* in MSA *m* in period *t* we estimate parameters from the following equation:

$$(16) \qquad I_{imt} = \lambda_m + \phi_1 MergerHHI_{mt} + \phi_2 \ln NHMO_{mt} + \delta W_{imt} + \sum_{t=1991}^{2003} \gamma_t year_t + \nu_{imt} ,$$

where λ_m is an MSA fixed effect, $NHMO_{mt}$ is the number of HMOs operating in the MSA, W_{imt} is a vector that includes a rich set of individual demographic controls and MSA-level characteristics and v_{mt} is the residual. The parameter ϕ_1 measures the impact of hospital mergers on the likelihood of insurance take-up and is the parameter of primary interest.

[9] To test the robustness of our results to different specifications, we included an HMO HHI Index in the premium regression. The results of this estimation are qualitatively identical to those we present here.

As in the HMO premium analysis, we follow the theory by estimating the parameters of (16) separately for three different samples, split roughly by thirds of the population-weighted number of HMOs in 1995.[10] The samples are zero to six HMOs, seven to nine HMOs, and ten or greater HMOs.

C. Hospital Market Structure and Mergers

Our main right-hand-side variable of interest in both empirical specifications is $MergerHHI_{mt}$ which measures the accumulated change in hospital bed-based concentration solely due to consolidation. The advantage of using this measure over the more common *HHI* is that the standard *HHI* is more prone to endogeneity even controlling for location fixed effects. For example, hospital exits and changes in the distribution of beds are likely correlated with changes in hospital demand and those changes, in turn, may be related to shocks in insurance coverage. Of course, changes in $MergerHHI_{mt}$ could be correlated with unobserved insurance shocks, but, as we discuss below, the evidence we can bring to bear suggests changes in $MergerHHI_{jt}$ are exogenous.

At the market level, $MergerHHI$ is calculated by taking the market shares of hospital physical plants in 1990 and then assigning those hospitals to the organization to which they belong in year *t*. Letting $s_{m,1990}$ denote the market share based on the staffed bed size of organization *m* in 1990,

$$(12) \qquad MergerHHI_{mt} = \sum_{m=1}^{M} s_{m1990}(O_{mt})^2$$

[10] We explored using different years to define the three different samples. The qualitative results are unaffected by the choice of years used to define the samples.

where O_{mt} is the ownership/system structure of hospitals in period t. While $MergerHHI_{mt}$ is highly correlated with the traditional HHI, the change in $MergerHHI_{mt}$ over time is solely due to changes in ownership and hospital system structure. This measure treats exiting hospitals as remaining in the market and does not include new entrants in the measure of concentration. The vast majority of the change in the standard HHI in our data is due to mergers. Thus, while we think it useful to separate changes in the HHI due to consolidation, our results are robust to using a standard HHI measure.[11]

D. Identification

The Department of Justice and the Federal Trade Commission were not passive observers of the hospital merger wave in the 1990s. Both agencies brought several suits attempting to enjoin hospital mergers and in each case the courts sided with the hospitals. The courts' rulings effectively implied that hospital were to be held to a more lenient antitrust standard than other industries (Greaney, 2002).[12] In fact, the antitrust agencies' failure in court may have precipitated the merger wave. Because of the reduced antitrust scrutiny hospital mergers enjoyed over this period, our sample of hospital mergers is not a selected sample of transactions that would typically need to pass traditional antitrust scrutiny. That is, the hospital industry over this period serves as an experiment of the welfare consequences of significantly reduced antitrust oversight.

Our key identifying assumption is that ε_{jt} and υ_{imt} are uncorrelated with $MergerHHI$ in the HMO premium and health insurance analysis, respectively. It is

[11] We considered using *Merge rHHI* as an instrument for the standard HHI measure in an instrumental variables regression and our qualitative conclusions are robust to this specification.

[12] This string of losses was recently reversed in a case brought by the Federal Trade Commission. In *FTC v. Evanston Northwestern Healthcare Corporation* (2005) (File No. 011 0234, Docket No. 9315) the Court ruled in favor of the FTC and ordered previously consolidated hospitals to de-merge. This case is currently under appeal.

reasonable to ask under what other scenarios the shocks to HMO premiums, ε_{jt}, and the shocks to health insurance status, υ_{imt}, are correlated with $MergerHHI_{jt}$ and how likely are those scenarios?

In the HMO analysis, positive HMO demand shocks mean the potential rents a hospital can extract via merger have increased and may overcome any transaction costs. However, hospital mergers are very complex transactions taking years to initiate, negotiate and complete and inherently embody significant uncertainty over the time to completion. It would be very difficult for these organizations to forecast demand shocks and time their merger to take advantage of those shocks. However, if these shocks are not independent over time, then it plausible they could be correlated with $MergerHHI_{jt}$. If this were the case, we should expect $MergerHHI_{jt}$ to be correlated with other, more easily observed, demand and cost side variables. Also, if the shocks are foreseeable and unless hospitals can accurately time the consummation of their transaction, then leads and lags of $MergerHHI_{jt}$ should be correlated with HMO premium. This logic suggests that another indirect test of our specification is to estimate the model with leading and lagged values of $MergerHHI_{jt}$.

We estimated a fixed-effects regression of HMO-level demand (average HMO penetration, average logarithm of population, average size distribution of firms, number of physicians, percent Medicare, percent Medicaid, and nurses' wages) on $MergerHHI_{jt}$. The results are consistent with the hypothesis that hospital consolidations are uncorrelated with HMO demand and cost shifts. None of the coefficients on demand and cost variables were significant at traditional levels of confidence. That is, $MergerHHI_{jt}$ is uncorrelated with the observable measures of demand and costs. This provides some indirect evidence that $MergerHHI_{jt}$ is exogenous.

In addition, we estimated the coefficients in (15) including leading and lagged values of $MergerHHI_{jt}$ to test whether there are premium shocks that are autocorrelated with $MergerHHI_{jt}$ but are unrelated to hospital merger activity. In all specifications the coefficients on the leading and lagged values of $MergerHHI_{jt}$ are insignificant. This suggests that any endogeneity that would confound our findings must be contemporaneous with the merger activity and that strikes us as unlikely.

Likewise in the insurance take-up analysis, identification of the impact of hospital mergers comes from within-MSA variation in hospital merger activity. While we control for time-invariant, unobserved differences across MSAs and we include a rich set of demographic and geographic controls, it is nevertheless reasonable to ask if $MergerHHI_{mt}$ is correlated with shocks to health insurance status. For example, a possible source of endogeneity is that markets that experience other disruptions that affect insurance status also experience more merger activity.

While such endogeneity is plausible, we found little indirect evidence for it. For example, observable demand proxies do not appear to be correlated with $MergerHHI_{mt}$. Town, et al. (2005) found little correlation between the level of hospital merger activity and any inpatient demand variable. Interestingly, the level of merger activity is uniformly distributed across the major geographic regions. Importantly, they did not find an association between HMO penetration and hospital merger activity.

As in the premium analysis, we can test for the presence of factors that are autocorrelated with MSA merger activity by adding leads and lags of $MergerHHI_{mt}$ to the regression.[13] As long as these unobservable shocks are not coincident with $MergerHHI_{mt}$, a prospect we believe is unlikely, the indirect tests of exogeneity of $MergerHHI_{mt}$ are consistent with that hypothesis.

Finally, our theory predicts that hospital merger activity should impact unconcentrated HMO markets more than concentrated ones, and part of our identification strategy is to compare the impact of hospital mergers in concentrated HMO markets with unconcentrated markets. For endogeneity to impact our conclusions the error terms in the analysis would have to be correlated with $MergerHHI_{mt}$ only in some markets but not in other markets.

Given that we believe that $MergerHHI_{mt}$ is exogenous in our analysis, it is an open question of why some areas experienced significantly more hospital merger activity than other areas. The literature has found that the role and influence of business consultants, which differ significantly across hospitals, is associated with consolidation strategies (APM/University Health System Consortium (1995); Burns and Pauly (2002); Bazzoli, LoSasso, Arnould, and Shalowitz (2002); Burns, L.R., Bazzoli, G.J., Dynan, L. and Wholey, D.R. (1997)). If the use of consultants is driven by management styles and those styles are unrelated to other supply or demand shocks, it provides an account of the variation in merger activity that is exogenous in our empirical specifications.

[13] One possibility is that a decline in the percentage of the population that has private health insurance leads to a decline in hospital demand and that provides an incentive for future hospital mergers in response to the decline in demand. From conception to completion, hospital mergers take a significant amount of time (a minimum of 2 years), thus unless hospitals can forecast these demand declines and organize a consolidation response to them, hospital consolidation would occur in response to a contemporaneous shift in demand.

V. Data

Our data come from three primary sources: The American Hospital Association (AHA) Annual Survey, InterStudy, and the Current Population Survey. These data are supplemented with information on location characteristics that are available from the Census Bureau and the Area Resource File.

A. American Hospital Association Data

The AHA collects information on location, characteristics and ownership of over 95% of hospitals with 300 or more beds. We use annual data from 1990 to 2003, from which we define a sample of private (i.e. non-government), short-term, acute care, general medical and/or surgical hospitals. Psychiatric and rehabilitation hospitals are excluded from the analysis. Of particular interest is the AHA's list of hospital mergers which we use, along with the information on system change, to formulate our measures of ownership structure. The AHA tracks hospital system affiliation and records consolidation between hospitals if one hospital joins the system in which the other hospital is a member. A consolidation can also occur if a hospital is deleted from the AHA data and is listed as merging with another hospital. We use a "corrected" AHA system ID constructed by Kristin Madison which has been updated by researchers at Carnegie Mellon University.[14]

B. InterStudy Data

The population of HMOs is specified using data from the InterStudy Census (InterStudy, 1985-1987; InterStudy, 1988-2001) and the Group Health Association of

[14] We thank Kristin Madison, Marty Gaynor and colleagues for providing us with this data. See Madison (2004) for more information on this data.

America (GHAA) HMO Directories. InterStudy and GHAA also are the sources for HMO location, founding year, model type, not-for-profit status, federal qualification, national affiliation, counties where the HMO operates, and enrollment information. The financial data used to measure commercial premiums come from annual reports filed with state regulators that have been collected by different organizations.

Into the HMO data we merged county-level market measures from the Area Resource File (ARF) compiled by the Bureau of Health Professions of the U.S. Department of Health and Human Services. State-level wage data came from the Bureau of Labor Statistics of the U.S. Department of Labor. We obtained these reports and surveys and linked them together. The method of aggregating data to the HMO level is described in Town, Wholey and Feldman (2004).

Premiums are calculated as total premium revenue divided by total member months for commercial products. The market boundaries used to calculate $MergerHHI_{jt}$ are Health Services Areas (HSAs) (Makuc et al., 1991). A HSA is defined as one or more counties that are relatively self-contained with respect to the provision of routine hospital care. We then formulate the HMO level value of $MergerHHI_{jt}$ for each HMO in each period by taking a weighted average of the estimated HMO enrollment (as defined below) over the HSAs where it operates.

In the HMO premium regressions we include a broad set of variables formulated from the InterStudy/GHAA/ARF data. These variables control for HMO and market-level characteristics that may be correlated with premiums and $MergerHHI_{jt}$. The list of control variables is provided in Table A1.

Table 1 presents summary statistics for many of the variables used in the premium analysis. Premiums rose modestly over the decade from an average $123 per member per month in 1990 to $145 in 2000. Concordantly, the $MergerHHI_{jt}$ rose substantially from .1686 in 1990 to .1886 in 2000, while there was little net change in average number of HMO competitors.[15] There was also a significant change in the distribution of HMO organizational forms over the decade. Network HMOs, Independent Practice Organizations (IPAs) and group HMOs declined, while "Mixed" forms increased substantially.[16] There was also a decrease in the percentage of not-for-profit HMOs from 70% in 1990 to 66% in 2000.[17] The percentage of enrollees from the Medicare and Medicaid programs grew substantially over the decade. By 2000, on average, they accounted for 6.7 and 9.6 percent of HMO enrollees, respectively.[18]

C. Current Population Survey Data

To study the impact of hospital mergers on insurance take-up, we analyze data from the March Supplement of the CPS from 1990 to 2003. The CPS is a large, nationally representative survey of households. We limit our analysis to civilian adults between the ages of 22 and 62 because the inclusion of the younger population introduces the possibility that the Medicaid expansions may confound our estimates.[19] The CPS provides information on whether an individual had health insurance from any source, whether an individual had health insurance from a non-government source, age, race,

[15] Over this period there was significant HMO entry. However, HMO consolidation apparently had an off-setting impact on HMO concentration.
[16] These shifts suggest that premium trends may be associated with the organizational forms. In the analysis of HMO premiums we control for this possibility using organizational form-specific time trends as well as for-profit status time trends.
[17] Town, Wholey and Feldman (2004) find that HMO for-profit status conversions had little effect on premiums.
[18] We do not have data for the number of Medicare and Medicaid enrollees by HMO for 1990.
[19] Of course, many adults in our sample may qualify for Medicaid coverage.

ethnicity, education, family size, household income, employment status, and the employer size.

In 2000, the Census Bureau implemented significant changes in the CPS. The most important for our purposes is a change in the health insurance questions. Prior to 2000, the Census Bureau used a "residual" approach to classify health insurance coverage (Davern et al., 2003). The surveyors asked several yes/no questions about the types of health insurance coverage held by the respondent. If the respondent answered "no" to all the questions they were assumed not to have health insurance. In 2000, the survey was modified to verify whether the person who answered "no" to all questions, in fact, did not have health insurance. Approximately 8.1 percent of the 2001 respondents who did not answer "yes" to the standard health insurance questions reported actually being insured when asked. We recoded the 2000-2003 data so that it is consistent with earlier surveys.[20]

We treat the relevant market for hospital services as the Metropolitan Statistical Area (MSA) because this is the smallest geographic unit in the CPS that we can merge with the hospital consolidation data. We used the MSA code to match the individual information to information on hospital and $MergerHHI_{mt}$ from the AHA and InterStudy data. All AHA and InterStudy data are aggregated to the MSA level.

The MSA is not the ideal geographic market definition for the CPS analysis because the geo-political boundaries of MSAs are not necessarily related to hospital market boundaries. To address this problem we limit our sample to MSAs between 100,000 and 4,500,000 in 1990 population. The lower bound on the size of the MSA was chosen because small MSAs may be too narrow to define hospital markets. Practically

[20] This correction affects the magnitudes and precision of our estimates but not the qualitative conclusions. See www.shadac.org for an algorithm to implement this correction.

speaking, we also found few CPS observations from MSAs less than 100,000 in population. An upper bound was selected because in large cities the MSA likely overstates the boundary of the hospital market potentially introducing significant measurement error in $MergerHHI_{mt}$.[21] Observations that were not in an MSA were not used to estimate the coefficients but are used in assessing the impact of hospital mergers on welfare.

Instead of treating MSAs as markets, we would like to define the geographic market boundaries using patient hospital choice information as in Kessler and McClellan (2000). However, that exercise would require more detailed information on the location of a household than is available in the CPS. Kessler and McClellan (2000) compared their data-driven Herfindahl measures to Herfindahl indexes derived using a fixed circle about the hospital to define markets and found conclusions regarding the impact of competition were sensitive to how the concentration measures were formed. Because our market definition is significantly different from the definition Kessler and McClellan used to formulate their comparison HHI measure, the specific implication of their findings for our results is unclear. But, we have attempted to assess the impact of measurement error by estimating a model interacting $MergerHHI_{mt}$ with market size. The idea is that if there is measurement error it is likely correlated with market size. Our conclusions are robust to this specification. Nevertheless, the Kessler and McClellan research results point out a limitation of our work – the possibility of measurement error in market boundaries that translates into measurement error in the calculation $MergerHHI_{mt}$ over time.

[21] Again, our results are robust to a number of different thresholds and the exclusion of any thresholds.

A list of control variables used in the analysis of insurance take-up is provided in Table A1. Table 2 presents summary statistics of the CPS sample. The percentage of individuals with private health insurance declined by two percentage points over the decade and the percentage of individuals with any health insurance declined by three percentage points. As in the HMO data, hospital concentration increased substantially due to mergers. Over the decade the average $MergerHHI_{mt}$ increased to .2783 from an initial level of .1909. Except for Hispanic status (which increased 10 percentage points), most of the demographic variables were relatively constant over the sample period.

VI. Results

A. Impact of Hospital Mergers on HMO Premiums

Table 3 presents the fixed-effects regression coefficients of the logarithm of average HMO premiums on the logarithms of average $MergerHHI_{jt}$ and the average number of HMOs. In the full sample, the coefficients on both $MergerHHI_{jt}$ and logarithm of $NHMO$ are small and not significantly different from zero at traditional levels of confidence.

The second column of Table 3 presents the estimates from the sample of HMOs whose average $NHMO$ is greater than or equal to ten. The coefficient on $MergerHHI_{jt}$ is positive and significant (t-statistic = 2.83). For the other two HMO samples the estimated coefficients on $MergerHHI_{jt}$ are small in magnitude and insignificant at traditional levels of confidence. These results suggest that in less competitive HMO markets hospital mergers redistribute market power rents between hospitals and HMOs and may not have any impact of social welfare.

For HMOs that, on average, appear to face substantial competition, the coefficient estimates imply an HMO premium elasticity of $MergerHHI_{mt}$ of .085. This estimate implies that an increase in the average $MergerHHI_{mt}$ from .20 to .28 (this is the "standard hospital merger" in Gaynor and Vogt (2000)) will increase average premiums by approximately 2.9%. We can translate this premium increase into an implied increase in the price of inpatient care. Hospital expenditures comprise about 30% of HMO expenditures and if we assume a fixed-proportions technology and a 100% premium pass-through, our estimate suggests that an increase in the average $MergerHHI_{mt}$ from .20 to .28 raised the average price of inpatient hospital services by approximately 10%. This estimate is in the heart of the distribution of estimated price increases from the literature on hospital competition discussed in Section II.

B. Impact of Hospital Mergers on Health Insurance Consumers

If hospital mergers raise the price of inpatient care, then they should affect the quantity of health insurance consumed by consumers. We explore that possibility in this section. As discussed above, we divide the merged CPS data into samples roughly corresponding to thirds of the population-weighted, 1995 number of HMOs in an MSA. Again, those samples are zero to six, seven to nine, and ten or greater HMOs.

Table 4 presents fixed-effects estimates of the likelihood of civilian adults having private health insurance by degree of HMO competition. The first column of Table 4 presents the results from the entire sample. The coefficient of $MergerHHI_{mt}$ is negative, small in magnitude and insignificant and the coefficient of the logarithm of the number of HMOs is positive but not significant at traditional levels of confidence.

Column (2) of Table 4 presents the estimate of the impact of hospital mergers on the probability of having private health insurance for adults living in MSAs in the most competitive HMO markets. The coefficient of $MergerHHI_{mt}$ is negative, large in magnitude and significant at the 5% level of confidence (absolute value of t-statistic = 3.27). That is, hospital mergers in these MSAs are estimated to reduce the amount of health insurance purchased from private sources. The coefficient estimates imply that a hospital merger that an increase in $MergerHHI_{mt}$ from .20 to .28 reduces the likelihood of having private insurance by .013. Using the estimates of the premium impacts from hospital mergers presented above in combination with these estimates implies a private insurance semi-elasticity ($\frac{\Delta \text{Prob Private Insurance}}{\%\Delta \text{ Premium}}$) of -.45, which is in the middle of the range of estimates from the literature. For example, at the high end of the spectrum Gruber and Poterba (1994) estimate a semi-elasticity of demand for health insurance for the self-employed of -1.8. At the low end Chernew, Cutler and Keenan (2005) estimate the insurance semi-elasticity for private insurance to be -.10.

Table 5 presents the fixed-effects estimates of the likelihood of civilian adults having health insurance from any source by the degree of HMO competition. The patterns of coefficient estimates are similar to those presented in Table 4. In column (2) of Table 5 the coefficient of $MergerHHI_{mt}$ for MSAs with ten or more HMOs in 1995 is -.15 and is precisely estimated (absolute value of t-statistic = 2.54). Interestingly, this coefficient is similar to the corresponding coefficient in Table 4. This result, along with the results in Table 4, suggests that the vast majority individuals who drop private insurance because of a premium increase become uninsured. The coefficient estimates of $MergerHHI_{mt}$ for the other MSA samples are small and insignificant.

The results of Table 3, 4 and 5 suggest that hospital mergers lead to increases in health insurance premiums in competitive HMO markets, and the increases in HMO premiums lead to a decline in private health insurance take-up and an increase in the uninsurance rate. If hospital mergers cause health insurance premiums to increase, for a number of reasons we should expect poorer individuals to be more sensitive to premium increases and thus more affected by hospital mergers in competitive HMO markets. To test this hypothesis, we formulate two samples from the CPS based on household income and estimate the impact of hospital mergers on the likelihood that those living in MSAs with competitive HMO markets possess private health insurance or any health insurance at all. The first group comprises individuals with household income under $60,000, and the second group is individuals with household income above $60,000.

Table 6 presents the results of this exercise. The coefficient estimates indicate that hospital mergers reduced the likelihood of acquiring private insurance for the low-income group. In column (1), the coefficient on $MergerHHI_{mt}$ is -.22 and significant at the 5% level. For the upper-income sample (column (2)) hospital mergers did not significantly affect the likelihood of private insurance take-up. This pattern also holds when the dependent variable is the presence of any insurance. The coefficient on $MergerHHI_{mt}$ is -.20 and the absolute value of the t-statistic is 2.53. The results in Table 6 are consistent with hospital mergers leading to higher health insurance premiums in unconcentrated HMO markets, with the impact of the premium increases on insurance take-up limited to the poorer half of the income distribution.

C. Robustness

Table 7 presents the most important of many robustness checks we performed on these analyses. The most obvious concern is that $MergerHHI_{mt}$ is endogenous. That is, unobserved shocks to insurance may drive hospital mergers. To test this possibility we included two-year leads and lags of $MergerHHI_{mt}$ as additional right-hand side variables. The logic underlying this test is that unobserved trends in insurance may be correlated with hospital mergers but this correlation is unlikely to be contemporaneous. So if $MergerHHI_{mt}$ is endogenous, a marker would be correlation between the leading or lagged values and insurance take-up. In addition, if hospital consolidation ultimately leads to efficiencies that are passed on in the form of lower prices but those efficiencies take some time to realize then coefficients of the lagged values of $MergerHHI_{mt}$ should be positive.

The first column in Table 7 presents the results with inclusion of the two-year leading and lagged values of $MergerHHI_{mt}$. In this specification, $MergerHHI_{mt}$ is negative and significant at the 1% level while the coefficients of both the lead and lag values $MergerHHI_{mt}$ are small in magnitude and insignificant.[22] These results suggest that endogeneity is not an issue. Furthermore, the results do not indicate that hospitals are able to achieve efficiencies through merger over time and pass them on to consumers in the form of lower health insurance premiums.

[22] In a regression of health insurance status on contemporaneous, one and two-year lagged values of $MergerHHI_{mt}$, the coefficients on the lagged values of $MergerHHI_{mt}$ are small and insignificant while the coefficient on contemporaneous $MergerHHI_{mt}$ is large. This suggests that our results are robust to potential measurement differences in the reported time of insurance status and hospital consolidation.

Columns (2) – (5) of Table 7 present the results using different HMO concentration cut-off values to define the most competitive HMO markets. Consistent with our theory, the coefficient on $MergerHHI_{mt}$ declines as the threshold on the number of HMOs decreases. Above eight HMOs the coefficient becomes insignificant in the private health insurance take-up regression, while the coefficient becomes insignificant above nine HMOs in the regression for any health insurance.

We re-estimated the coefficients on the sample that excluded the years 1990-1992, 1994-1996, and 1998-2000. The coefficient estimates and standard errors were not meaningfully different than those presented in Tables 3 and 4. We also dropped MSAs with very large and very small changes in the private health insurance rate to see if our estimates are sensitive to outliers. Again, the coefficients and standard error estimates from this analysis are in line with results present above.

We estimated the model using different definitions of the hospital organizational boundary. Specifically, we define an organization as one that generates one financial report in the AHA data. Dranove and Lindrooth (2004) found that hospital mergers where the newly formed organization consolidated its financial reports generated significant cost reductions. These results are reported in Table A2 in the Appendix. Consistent with the results of Dranove and Lindrooth (2004), changes in hospital concentration using this definition of the hospital organization did not impact health insurance take-up.

D. The Welfare Impact of Hospital Mergers 1990 -2003

Table 8 shows the effect of an implied increase in HMO premiums due to hospital consolidations from 1990 onwards. Premium increases as a consequence of hospital consolidation were very modest until the late 1990s but by 2001, the last year for which we have premium data, our estimates imply that HMO premiums were 3.2% higher than they would have been absent horizontal hospital consolidation.

Table 9 examines the impact of hospital consolidation on health insurance take-up rates. By the late 1990s, hospital mergers had a modest but non-trivial impact on health insurance take-up. In 2003, the rate of private insurance is estimated to be .0046 lower because of hospital consolidation, while the uninsurance rate is estimated to be .0043 higher. This translates into approximately 695,000 (.5%) fewer covered lives in private health insurance with most of these (650,000) joining the ranks of the uninsured. Over the entire 14 years of our sample, we estimate that private insurance decreased by 5.9 million covered life-years and uninsurance increased by 5.5 million covered life-years.

Using the estimates from Tables 8 and 9 we can calculate rough, back-of-the-envelope estimates of the welfare loss (and the decomposition of that loss) from hospital consolidations during our study time period. We estimate the change in consumer surplus and the dead weight loss in the simplest possible way – we assume a linear demand function and constant marginal cost. There are numerous limitations associated with this exercise. We do not account for heterogeneity in preferences and in health insurance plan structures. We also assume that the premium increases due to hospital mergers we estimate for HMOs apply to all forms of private health insurance. We do not account for the possibility that hospital mergers may result in efficiencies that can increase hospital profits.[23] We also are not taking into account the impact of hospital mergers on the use of inpatient services by either the insured or uninsured or the structure of insurers hospital

[23] Dranove and Lindrooth (2004) estimate that hospital mergers in which the hospitals consolidate their financial statements result in cost reductions of approximately 14%.

networks.[24] Finally, we consider only the net decline in insurance coverage – those people who lost private coverage but gained public coverage are not considered to have lost any consumer surplus.

Table 10 presents these calculations. Recall that our sample is civilian adults between ages 22 and 62. By 2001, hospital consolidations reduced consumer surplus for this sample by $7.4 billion (about 2.8% of total private insurance revenues) or $49.82 per capita. From 1990 to 2001, total consumer surplus was reduced by $42.2 billion. Total welfare loss was quite modest, however. By 2001, net welfare loss from horizontal hospital consolidations was a mere $19.7 million and the total net welfare loss from 1990 to 2001 was $95.7 million. That is, it appears that the primary impact of hospital mergers was to transfer consumer surplus to hospitals.

VII. Conclusion

The hospital industry enjoyed reduced antitrust scrutiny while it consolidated in the 1990s. Our work suggests that hospital consolidation resulted in non-trivial consequences for health insurance consumers. Hospital consolidation caused private insurance rolls to decrease and the number of US residents without health insurance to increase. Thus, if the goal of antitrust policy is to prevent consolidations that reduce consumer surplus independent of the impact on profits, then during the 1990s the courts' rulings on hospital mergers ran counter to this goal. Currently, the Federal Trade

[24] It is possible that insurers react to increased hospital prices by increasing inpatient co-pays and that, in turn, would impact enrollee welfare. We are not in possession of the data to explore this possibility. However, our results suggest that the majority of the changes in hospital prices are passed along in the form of premium increases in competitive HMO markets. Ho (2006) has analyzed the impact of restricted hospital network choice on health insurance beneficiaries and finds that selective contracting leads to $1 billion in societal welfare loss across 43 metropolitan areas. Estimating the impact of hospital mergers on HMO network structure is a formidable task and beyond the scope of this paper. Ho (2005) has made some progress on this problem.

Commission is reviewing and in some cases challenging consummated hospital consolidations. Our work suggests that such challenges may be justified. However, if the purpose of antitrust policy is to prohibit only those mergers that reduce total welfare, a view with which many economists concur, then our results suggest that the courts were correct in their assessment of the impact of hospital mergers. There was very little welfare loss from hospital consolidations during the 1990s.

Our work also makes a modest contribution to merger analysis when the merging firms are upstream from the final product. The important point we make there is that the impact of an upstream merger on the final consumers is a function of the downstream market structure.

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Table 1

Summary statistics of HMO estimation sample

Variable	Full Sample	Year		
		1990	1995	2001
HMO Premium (2000 dollars)	\$133.62 (26.86)	\$122.62 (24.74)	\$136.20 (26.73)	\$145.55 (26.70)
$MergerHHI_{jt}$	.1766 (.1092)	.1686 (.976)	.1710 (.111)	.1868 (.1157)
Average Number of HMOs	9.39 (4.17)	8.91 (5.05)	9.38 (3.86)	8.26 (2.77)
Enrollment	127,941 (243,889)	73,806 (164,190)	111,744 (204,271)	212,024 (360,957)
Age in Years	12.6 (8.73)	8.6 (7.6)	12.1 (8.5)	17.3 (9.07)
Percent For-Profit	68.5	66.4	69.7	70.7
Percent Network HMO	9.3	13.8	8.3	10.9
Percent IPA HMO	58.3	65.4	59.3	50.9
Percent Group HMO	6.4	10.4	6.8	2.6
Percent Staff HMO	4.4	8.5	3.4	1.1
Mixed HMO	21.7	1.9	22.1	34.5
Percent Enrollment Medicare	4.3	--	3.6	6.7
Percent Enrollment Medicaid	6.4	--	5.6	9.6
N	3,340	318	350	267

Note: Means are not weighted by enrollment

Table 2

Summary statistics of CPS sample
Means and standard deviations in parentheses

Variable	All Years	Year 1990	Year 1997	Year 2003
Private Health Insurance	.80 (.40)	.81 (.38)	.80 (.40)	.80 (.40)
Any Health Insurance	.82 (.39)	.82 (.38)	.82 (.39)	.83 (.34)
Age	39.4 (10.4)	38.2 (10.5)	39.5 (10.3)	40.4 (10.2)
Female	.46 (.50)	.45 (.50)	.47 (.50)	.47 (.50)
Married	.64 (.48)	.64 (.48)	.64 (.48)	.65 (.48)
White	.86 (.35)	.87 (.33)	.86 (.34)	.83 (.37)
Black	.089 (.28)	.084 (.28)	.086 (.28)	.099 (.30)
Hispanic	.11 (.32)	.086 (.28)	.12 (.33)	.14 (.35)
Bachelors or Advanced Degree	.31 (.46)	.30 (.45)	.30 (.45)	.31 (.45)
Union Member	.03 (.18)	.04 (.19)	.03 (.18)	.03 (.18)
Full Time Worker	.80 (.39)	.81 (.38)	.81 (.38)	.81 (.36)
Unemployed	.078 (.25)	.064 (.24)	.041 (.20)	.053 (.22)
Employer ≥ 1,000 employees	.45 (.50)	.41 (.49)	.47 (.50)	.45 (.50)
Household Income	$68,070 (53,590)	$63,037 (41,093)	$67,877 (57,337)	$74,177 (63,447)
$MergerHHI_{mt}$	.2395 (.17)	.1909 (.14)	.2490 (.17)	.2783 (.18)
Number of HMOs	7.90 (4.00)	5.11 (3.17)	10.1 (4.3)	7.63 (3.43)
N	467,136	32,532	31,253	52,160

Table 3

Fixed-Effects Estimates of the Impact of Hospital Consolidation on HMO Premiums
(bootstrapped standard errors in parenthesis)

Variable	Dependent Variable is Logarithm of HMO Premium			
	Sample			
	Full Sample (1)	1995 Mean Number HMOs ≥ 10 (2)	1995 Mean Number HMOs ≥ 7 & HMOs <10 (3)	1995 Mean Number HMOs <7 (4)
Log Hospital Merger HHI	.0026 (.0051)	.085** (.030)	-.043 (.037)	-.00071 (.0098)
Log Average Number of HMOs	-.011 (.020)	.056 (.038)	.0020 (.017)	-.059 (.034)
Within R^2	.25	.28	.32	.31
Overall R^2	.12	.077	.22	.078
N	3,345	1,435	875	1,035
Number HMOs	374	159	97	118

Note: Right hand side variables include age of the HMO, mean HSA per capita income, mean HSA population, mean percent HSA with collage degree, mean HSA poverty rate, mean HSA hospital beds per capita, mean percent HSA over 64 years of age, mean HSA MDs per capita, mean HSA unemployment rate, mean HSA population density, mean HSA nurse wage, the mean distribution of employers across size categories, time trends interacted with HMO type and annual dummies. Standard errors are clustered at the HMO level.
* Significant at the 5% level.
** Significant at the 1% level.

Table 4

MSA Fixed-Effects Estimates of the Impact of Hospital Consolidation on Probability of Private Health Insurance for MSA under 4,000,000 in population (bootstrapped standard errors in parenthesis)

Variable	Dependent Variable is Indicator of Private Insurance Sample			
	Full Sample	1995 Number of HMOs ≥ 10	1995 Number of HMOs ≥ 6 & < 10	1995 Number of HMOs < 6
	(1)	(2)	(2)	(2)
Merger HHI	-.0073	-.16**	.0015	.040
	(.024)	(.049)	(.035)	(.041)
Log Number of HMOs	.0011	-.0072	.018*	-.0062
	(.0024)	(.0079)	(.0080)	(.0038)
Within R^2	.25	.25	.25	.24
Overall R^2	.25	.24	.25	.24
N	509,178	225,267	155,039	128,872
Number MSAs	250	57	74	119

Right hand side variables include age, household income, household income squared, household income cubed, family size, household income per family member, indicators for race, Hispanic status, employment status, union status, marital status, high school graduate, college graduate, post-baccalaureate education, veteran status, household income interacted with martial status, household income interacted with female, time trend interacted with bottom decile of income distribution, time trend interacted with 2nd decile of income distribution, time trend interacted with fulltime work status, time trend interacted with household income, employer size indicators, occupational indicators, industry indicators, MSA per capita income, MSA population, percent MSA with collage degree, MSA hospital beds per capita, percent MSA over 64 years of age, MSA MDs per capita, MSA unemployment rate, MSA hospital beds per capita and annual dummies. Standard errors are clustered at the MSA level.

**Significant at the 1% level.

*Significant at the 5% level.

Table 5

MSA Fixed-Effects Estimates of the Impact of Hospital Consolidation on Probability of Any Health Insurance
(bootstrapped standard errors in parenthesis)

Variable	Dependent Variable is Indicator of Any Insurance Sample			
	Full Sample	1995 Number of HMOs ≥ 10	1995 Number of HMOs ≥ 6 & < 10	1995 Number of HMOs < 6
	(1)	(2)	(2)	(2)
Merger HHI	-.0073	-.15**	.0069	.038
	(.024)	(.059)	(.050)	(.040)
Log Number of HMOs	.00032	-.0091	.016	-.0055
	(.0036)	(.0062)	(.0088)	(.0040)
Within R^2	.19	.19	.19	.17
Overall R^2	.19	.18	.19	.18
N	509,178	225,267	155,039	128,872
Number MSAs	250	57	74	119

Note: See Table 4 for list of control variables.
**Significant at the 1% level.
*Significant at the 5% level.

Table 6

MSA Fixed-Effects Estimates of the Impact of Hospital Consolidation on Probability of Private or Any Health Insurance by Household Income (bootstrapped standard errors in parenthesis)

Variable	Dependent Variable is Indicator of Private Insurance Sample is 1995 Number of HMOs ≥ 10			
	Dependent Variable is Private Insurance		Dependent Variable is Any Insurance	
	Household Income under $60,000 (1)	Household Income above $60,000 (2)	Household Income under $60,000 (3)	Household Income above $60,000 (4)
Merger HHI	-.22**	-.051	-.20**	-.048
	(.079)	(.062)	(.079)	(.056)
Log Number of HMOs	-.0038	-.014	-.0029	-.013
	(.012)	(.0095)	(.012)	(.0071)
Within R^2	.19	.13	.17	.13
Overall R^2	.16	.14	.16	.13
N	90,664	86,225	90,664	86,225
Number MSAs	57	57	57	57

Note: See Table 4 for a list of controls variables.
*Significant at the 5% level.
**Significant at the 1% level.

Table 7

Robustness Analysis
MSA Fixed Effects Estimates of the Impact of Hospital Consolidation

Variable	Dependent Variable is Indicator of Private Insurance				
	1995 Number of HMOs ≥ 10 (1)	1995 Number of HMOs ≥ 12 (2)	1995 Number of HMOs ≥ 11 (3)	1995 Number of HMOs ≥ 9 (4)	1995 Number of HMOs ≥ 8 (5)
Merger HHI	-.17* (.070)	-.24** (.065)	-.24** (.051)	-.12** (.043)	-.074* (.036)
Merger HHI(t+2)	-.047 (.057)	---	---	---	---
Merger HHI (t-2)	.10 (.061)	---	---	---	---
Log Number of HMOs	-.0029 (.012)	.0089 (.014)	-.0031 (.010)	-.0073 (.0068)	-.017 (.0045)
Within R^2	.26	.25	.25	.25	.25
Overall R^2	.22	.24	.24	.21	.23
N	132,273	99,873	161,077	247,575	308,984
Number MSAs	57	22	40	68	88
Variable	**Dependent Variable is Indicator of Any Insurance**				
Merger HHI	-.17* (.065)	-.27** (.087)	-.23** (.058)	-.11* (.044)	-.062 (.037)
Merger HHI(t+2)	-.022 (.067)	---	---	---	---
Merger HHI (t-2)	.083 (.071)	---	---	---	---
Log Number of HMOs	-.022 (.067)	.0060 (.010)	.0015 (.0090)	-.0072 (.0055)	-.0025 (.0059)
Within R^2	.20	.19	.19	.19	.19
Overall R^2	.17	.19	.19	.17	.18
N	132,273	99,873	161,077	247,575	308,984
Number MSAs	57	22	40	68	88

Note: See Table 4 for a list of controls.
*Significant at the 5% level.
**Significant at the 1% level.

Table 8

Mean Annual Per-Member Premium and Mean Percentage
Change in Premium Due to Hospital Mergers
(Means weighted by HMO Enrollment)

Year	Annual Premium (2000 dollars)	Percentage Increase in Premiums due to Hospital Mergers Across all HMOs	Percentage Increase in Premiums due to Hospital Mergers For HMOs in "Competitive HMO Markets"
1990	$1,488	--	--
1991	$1,584	.16	.26
1992	$1,704	.33	.54
1993	$1,716	.66	1.1
1994	$1,728	1.2	2.1
1995	$1,656	1.9	3.2
1996	$1,524	2.2	3.8
1997	$1,548	2.8	4.7
1998	$1,584	3.0	5.1
1999	$1,668	3.1	5.2
2000	$1,752	3.2	5.4
2001	$1,896	3.2	5.3

Table 9

Estimated Impact of Hospital Mergers on Quantity of Health Insurance for US Civilian Adults

Year	25-65 Civilian Population (millions)	Private Health Insurance Rate	Uninsurance Rate	Estimated Change in Private Insurance Rate	Estimated Change in Uninsured Rate	Estimated Decrease in Private Insurance Roles	Estimated Increase in Uninsured Population
1990	126.3	.787	.182	--	--	--	--
1991	128.5	.778	.190	-.00017	.00016	21,845	20,560
1992	130.6	.771	.193	-.00032	.00030	41,792	39,180
1993	132.6	.756	.206	-.00075	.00070	99,450	92,820
1994	134.6	.773	.190	-.0014	.0013	188,440	174,980
1995	136.7	.786	.180	-.0026	.0024	355,420	328,080
1996	138.9	.783	.182	-.0030	.0028	416,700	388,920
1997	141.1	.781	.182	-.0040	.0037	564,400	522,070
1998	143.0	.777	.191	-.0045	.0042	643,500	600,600
1999	144.9	.780	.190	-.0047	.0045	681,030	652,050
2000	146.2	.789	.190	-.0048	.0047	701,760	687,140
2001	147.7	.793	.181	-.0050	.0044	738,500	649,880
2002	149.5	.802	.168	-.0047	.0044	702,650	657,800
2003	151.3	.789	.178	-.0046	.0043	695,980	650,590
Sum						5,851,467	5,464,670

Table 10

Estimated Welfare Impact of Hospital Mergers 1990-2001

Year	Loss in Consumer Surplus ($1,000)	Per capita Loss in Consumer Surplus ($)	Total Dead Weight Loss ($1,000)
1990	---	---	---
1991	263,819	2.05	26
1992	588,588	4.51	109
1993	1,192,934	9.00	525
1994	2,262,577	16.81	1,814
1995	3,532,086	25.84	5,161
1996	3,785,930	27.26	6,468
1997	5,014,070	35.54	11,314
1998	5,511,716	38.54	14,270
1999	6,085,774	42.00	16,858
2000	6,612,866	45.23	19,129
2001	7,358,982	49.82	19,714
Sum	42,209,342	296.60	95,388

Figure 1

Mean Population-Weighted Hospital Concentration and
Number of Horizontal Hospital Mergers and Acquisitions -- 1990-2003

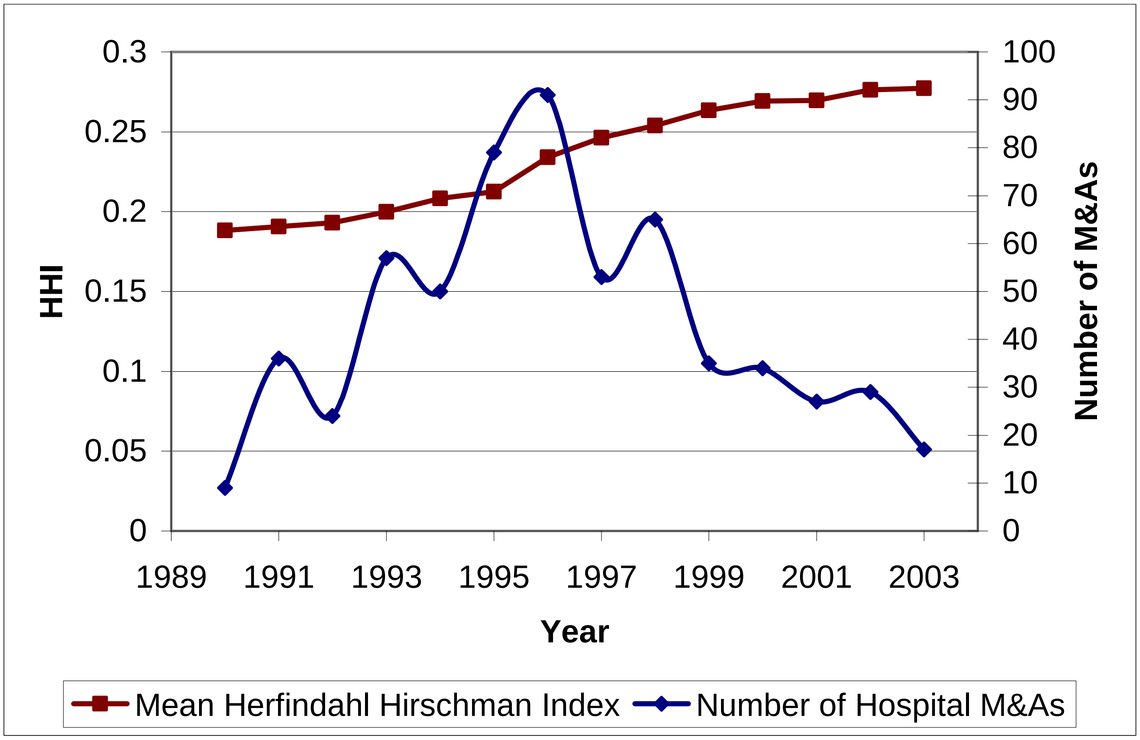

Table A1

Control Variables for HMO Premium and Insurance Take-up Analysis

HMO Premium Control Variables		Insurance Take-Up Control Variables	
HMO Variables	HSA Variables	Individual Variables	MSA Variables
HSA Penetration Rate	Percent of Establishments with 50 to 99 employees	Age Age^2 Female	Percent FP Hospitals MDs per capita Hospital Beds per capita
Log of enrollment	Percent of Establishments with 50 to 99 employees	Married Divorced Widowed	Log of MSA population Log of MSA per-capita Income
Trend and Trend squared interacted with FP, IPA, Network, Mixed indicators	Percent of Establishments with 100 to 249 employees	Black Asian Hispanic	Unemployment Rate Percent of population with college degrees
Log of HMO Age	Percent of Establishments with 250 to 499 employees	Veteran Status Union Status Log of Family Size	Trend interacted with 1990 Hospital HHI
	Percent of Establishments with 500 to 999 employees	Household Income Household Income^2 Household Income^3	
	Percent of Establishments with 1,000 or more employees	Household Income × Married Household Income × Female	
	Log of RN Wages	Per-capita Household Income Bottom 10% Income × trend	
	MDs per capita	Bottom 20% Income × trend	
	Log of per capita income	Indicators for Employer's Size	
	Unemployment rate	Educational Attainment Indicators	
	Poverty rate	Work Status Indicator	
	Log of number of establishments	Industry Indicators Occupation Indicators	

Table A2

MSA Fixed-Effects Estimates of the Impact of Hospital Mergers (system expansions not included) on Probability of Private Health Insurance for MSA under 4,500,000 in population (bootstrapped standard errors in parenthesis)

Variable	Dependent Variable is Indicator of Private Insurance Sample			
	Full Sample	1995 Number of HMOs ≥ 10	1995 Number of HMOs ≥ 6 & < 10	1995 Number of HMOs < 6
	(1)	(2)	(2)	(2)
Merger HHI	.0040	-.033	-.035	.032
	(.033)	(.098)	(.046)	(.040)
Log Number of HMOs	.0011	-.0080	.018*	-.0060
	(.0039)	(.0070)	(.0071)	(.0045)
Within R^2	.25	.25	.25	.24
Overall R^2	.25	.23	.25	.24
N	509,178	225,267	155,039	128,872
Number MSAs	250	57	74	119

Variable	Dependent Variable is Indicator of Any Insurance Sample			
	Full Sample	1995 Number of HMOs ≥ 10	1995 Number of HMOs ≥ 6 & < 10	1995 Number of HMOs < 6
	(1)	(2)	(2)	(2)
Merger HHI	.022	.052	-.010	.037
	(.029)	(.12)	(.042)	(.038)
Log Number of HMOs	.00026	-.0095	.016*	-.0050
	(.0028)	(.0071)	(.0080)	(.0054)
Within R^2	.19	.19	.19	.17
Overall R^2	.19	.18	.19	.17
N	509,178	225,267	155,039	128,872
Number MSAs	250	57	74	119

Note: See Table 4 for list of control variables.
*Significant at the 5% level.
**Significant at the 1% level.