2006-05

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National Bureau of Economic Research

NBER Working Paper No. 12241

NBER WORKING PAPER SERIES

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Working Paper 12241
http://www.nber.org/papers/w12241

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
May 2006

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JEL No. I1

ABSTRACT

Does quality of care systematically differ among government-owned, private not-for-profit, and for-profit hospitals? A large empirical literature provides conflicting evidence. Through quantitative review of 46 studies since 1990, we find that several study features that can explain divergent results: analytic methods, disease studied, and data sources. For unprofitable care, how studies handle market competition and regional differences account for substantial variation. Policymakers should be aware that differences in results appear to arise predominantly from differences between studies' analytic methods. Moreover, conventional methods of meta-analytic synthesis should be applied with great caution given the considerable overlap among studied hospitals.

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I. Background

Does quality of care systematically differ among government-owned, private not-for-profit, and for-profit hospitals? This question is of considerable policy importance in the United States and many other countries. A large empirical literature on this topic provides conflicting evidence. Unlike the clinical literature, systematic reviews and meta-analysis remain rare for such questions of health service delivery, and none to date focuses on explaining the heterogeneity in study results.

The objective of this systematic review is to examine what factors explain the diversity of findings regarding hospital ownership and quality of care, as well as measures of benefits provided to a hospital's surrounding community (including uncompensated care to the poor and uninsured and other unprofitable services). We employ meta-regressions to quantify heterogeneity explained by study-level variables hypothesized to effect results—such as each study's methodology to account for confounding factors, whether the study analyzes patient- or hospital-level data (or both), time period of the data or regions covered. Our review is part of a larger project applying meta-analytic techniques to the literature since 1990 on hospital ownership and performance; Shen and colleagues report the results on financial performance and ownership.[1]

The only previous systematic review of hospital ownership and quality of which we are aware identified 15 studies published between 1988 and 2001 comparing mortality rates among private not-for-profit and for-profit hospitals.[2] Our study differs from theirs in several respects: we focus on explaining variation, rather than suggesting "one overall answer"; we include studies analyzing patient outcomes other than mortality (e.g., adverse events), as well as measures of community benefits; we include government ownership in the review; we do not

exclude studies analyzing ownership conversions, but rather test the hypothesis that conversion studies differ systematically from others; and perhaps most importantly, we address the problem of applying conventional meta-analytic techniques to this literature because many studies analyze overlapping samples of hospitals. Our literature search identified 31 studies of patient outcomes and 15 studies analyzing various measures of community benefits that fit our inclusion criteria.

II. Methods

Literature Search, Selection and Extraction

Data Sources. Our literature search employed the keywords "hospitals," "ownership," "for-profit," "not-for-profit," "nonprofit," and their combinations. Databases included Medline, EconLit (Economics Literature), and Proquest/ABI (for dissertations), as well as hand search and work cited in previous qualitative reviews.[3] We included all published and unpublished articles or book chapters written in English between January 1990 and July 2004, initially resulting in 1357 potentially relevant studies. We identified 77 additional studies by asking corresponding authors for any new or unpublished work comparing hospitals of different ownership forms. (See Figure 2 of Shen et al. 2005 for literature selection process)

Study Selection. We selected studies of general, acute, short-stay hospitals in the United States that used multivariate analysis to study hospital performance. The hospital sample had to include hospitals from at least two of our three included ownership forms (government-owned, private not-for-profit and private for-profit). We excluded studies that only compared sub-categories of ownership (such as religious vs. secular private not-for-profits) or focused on hospitals of the Department of Veterans Affairs. From the 340 studies fitting these selection

criteria, we further narrowed down the field to studies examining one or more of the following outcomes: financial performance; patient outcomes (mortality, complications, and other adverse outcomes); uncompensated care, unprofitable services or other measures of community benefits; or staffing. Two authors (Eggleston and Shen) independently applied these selection criteria, achieving 7% discrepancy in coding, with consensus resolution of all differences. From the 169 citations that fell within this outcome scope, we excluded duplicates (such as dissertations and subsequently published papers), studies with very small sample sizes (fewer than 50 hospitals), and studies that did not report needed data (e.g., ownership coefficients in a regression) and for which authors were unable to supply that data.

Through this search and selection process, we identified 141 studies. In this paper, we report results from analysis of the 46 studies in two broad categories: 31 studies of patient outcomes; and 15 studies of uncompensated care, unprofitable services, or other measures of community benefits (henceforth referred to jointly as "unprofitable care"). We include the complete bibliography of the included studies in the appendix.

Data extraction. We extracted data needed to construct measures of treatment effect and to test our pre-specified hypotheses about underlying sources of heterogeneity in studies of hospital ownership. The data fields included each study's data sources; sampling frame (covered years, covered regions, number of hospitals and patients); detailed outcome definition(s); and the ownership coefficients and their associated statistics (such as standard errors, degrees of freedom of the empirical model, etc). Not all studies report the necessary statistics. For example, many policy journals report only the significance level of the coefficient. We contacted the corresponding authors to get the exact t-statistics where possible. In cases where we could not

get the exact number, we estimate the t-statistic by generating a random number within the reported significance range.

We coded each study's analytic methods using binary variables for whether the study included the following information: patient demographic characteristics; co-morbidities; hospital-level characteristics (such as bed size, share of Medicare and/or Medicaid admissions); market-level characteristics (such as per capita income, population size, concentration or competitiveness measures); and cross-sectional or panel data estimation methods. We also coded whether ownership variables were only included as control variables and not the main research question of the study, and whether the analyses explicitly address ownership conversion.

During the study design process we recruited and surveyed an expert panel of thirteen prominent researchers in the area of hospital ownership and performance who provided input on the research design.

Statistical Methodology

The 47 studies analyze diverse dependent variables. Even within a narrowly defined category (such as mortality), some dependent variables are measured as continuous variables at the hospital-level; others are dichotomous outcomes at the patient level. In order to have a standardized measure of ownership effect, we use the partial correlation coefficient to define each study's effect size based on statistics that are commonly reported in published studies (t-statistic and degrees of freedom), standardized using the Fisher transformation.[4] The partial correlation coefficient describes the relationship between the dependent variable and the ownership variable, holding other variables constant. It measures the correlation between a given ownership form and performance measure, controlling for the effect of covariates.

Explaining Variation in Study Results Using Meta-Regression Analysis. We employed random-effects meta-regression analysis to quantify to what extent various study characteristics account for heterogeneity of findings.[5] The dependent variable is the standardized effect size from each study. Empirical features of each study serve as explanatory variables. The regression model is necessarily parsimonious, given the limited number of studies in each category and the collinearity of many study features (such as data source and region covered).

We hypothesized that several factors might account for a substantial fraction of between-study variation in findings of patient outcomes. First, studies vary in the outcome analyzed (e.g., heart condition mortality vs. all-cause mortality) and in their unit of analysis: some use patient-level data, while others use aggregate data at the hospital level. We group studies according to the unit of their observations. Second, ownership differences might be affected by whether studies examine short-term or long-term mortality rates. Third, studies vary by the type of confounding factors they control for in the regression. Some studies were able to control for co-morbidities, while others did not. Fourth, we hypothesized that results might be driven by the underlying data sources: studies using Medicare claims might produce different results from those using all-payer data. Lastly, the variation in results might also be explained by the covered periods of the study and/or the regions studied. We also examined correlations among these individual factors. Limited sample size and collinearity precluded including all the hypothesized explanatory variables simultaneously.

For unprofitable care, we had even fewer studies, and all at the hospital level. Moreover, the analytical issues in unprofitable care are different from those of patient outcomes; market conditions are likely to play an even larger role. We categorize studies according to how they model market competition. Based on the theoretical and empirical literature, we hypothesize that

studies not explicitly accounting for hospital market competition are likely to find larger ownership differences than those that explicitly model hospital competition (for example, by implementing a selection model) or those that employ panel data estimation methods to minimize the unobserved heterogeneity across markets. We also explore whether regional differences explain heterogeneous results.

Overlapping samples problem. Conventional meta-analyses combine results from mutually exclusive patient populations. Yet many studies we reviewed analyze the same set of hospitals – and potentially the same patient outcomes – in overlapping years. There are fewer than 6000 hospitals in the United States; many hospital studies analyze national samples, and most use one or more of a few common data sources (Medicare claims or state-specific administrative data). For example, among the 31 patient outcome studies, the median hospital sample size per year is 1378. In another example, of the studies using Medicare claims data comparing private hospitals, almost three-quarters use data spanning both the 1980s and 1990s that is representative of hospitals from the whole country, suggesting significant overlap.

Our effect size measures, defined by partial correlation coefficients, should remain valid when observations are correlated.[6] However, the studies do not represent independent samples, and statistical power will not increase proportionally with each additional study's sample size. Thus, unlike most meta-analyses with independent samples, we do not report the combined effect size from the random-effects analyses. Our focus instead is on what explanatory variables help to account for the wide variation in study results.

Publication bias. We looked for evidence of publication bias by examining the relationship between the absolute value of t-statistics and the square root of degrees of freedom[7] as well as the traditional funnel plot; we do not find evidence of publication bias.

III. Results

Exhibit 1 summarizes our included studies. The 31 studies of patient outcomes include several analyzing multiple outcomes. 24 analyze short-term mortality (patient follow-up period less than 180 days), 6 analyze long-term mortality rates (including 5 that also analyzed short-term mortality), and 13 analyze other adverse patient outcomes, such as surgical complications or medical errors. We also review 15 studies on measures of unprofitable care: 9 analyze uncompensated care (charity care plus bad debt); 6 analyze unprofitable services; and 2 analyze a broader metric of community benefits (e.g., including services to public program beneficiaries, outreach efforts, etc.). Most studies of patient outcomes are representative of the entire United States, but more than half of the studies comparing private nonprofit and for-profit uncompensated care use data from California or Florida. Hospital sample sizes are often quite large, especially for studies using panel data, suggesting that many studies analyze the same hospitals in similar time periods. Many hospital-level analyses do not report patient sample sizes.

The effect sizes and their confidence intervals from random-effects models for patient outcomes and unprofitable care appear in Exhibits 2 and 3, respectively. In each case, Exhibit A summarizes studies comparing for-profits to private not-for-profits, and Exhibit B summarizes studies comparing government hospitals to private not-for-profits. A positive effect size indicates that for-profits (or government hospitals) are associated with a higher level of adverse events or unprofitable care, compared to private not-for-profit hospitals. The majority of studies find no statistically significant difference between not-for-profit and for-profit hospitals in mortality or other adverse events. Exhibit 2B illustrates that most studies that used nationally representative data find government hospitals to have higher short-term mortality rates than private not-for-profits, but less difference in long-term mortality or other adverse events. Exhibit

3A shows that most studies find either no difference or for-profit hospitals provide less unprofitable care than not-for-profits do. Exhibit 3B shows that studies using panel data estimation methods consistently find no difference between not-for-profit and government hospitals, whereas studies using cross-sectional data and methods have wider variation in sign and magnitude of their effect sizes.

In all cases the chi-square test for heterogeneity clearly rejects the null hypothesis that our combined studies are a homogeneous set (data not shown), thus validating our approach of using random effects regression models in our meta-regressions. Similar to studies of ownership and other aspects of performance[8], a plot of sample size and t-statistics does not reveal a pattern of t-statistics hovering around 2 regardless of sample size (not shown). Thus, we find no evidence of publication bias.

Explaining Variation in Studies Examining Patient Outcomes

Exhibit 4 presents our meta-regression results for variation in studies examining patient outcomes. Each panel represents a separate regression, since we have too few studies and too much correlation among some explanatory factors to include them all in one meta-regression. A positive coefficient indicates that for-profits (or government hospitals) are associated with a higher rate of adverse events than private not-for-profit hospitals. Note that the number of observations in the meta-regression does not correspond perfectly with that in the figures; the figures plot a single point for each study (e.g., averaging effect sizes across years if the study reported separate results for multiple years), whereas the meta-regressions use the separate estimates from such studies.

We first consider whether differences in type of patient outcome can explain variations in study findings about ownership. For comparisons between not-for-profit and for-profit hospitals, the estimated constant term indicates no statistically significant difference between private not-for-profits and for-profits for the 48% of studies analyzing all-cause mortality, the reference group. The 21% of studies analyzing all-cause patient outcomes other than mortality also find no difference. The remaining studies that focus on heart conditions find for-profits to have higher rates of adverse outcomes at a 5% level of significance. The low I-squared indicates that accounting for categories of patient outcome helps to explain significant heterogeneity across studies – in this case, the covariates explain 67% of the variation.

For comparisons of government hospitals to not-for-profits, the half of studies analyzing all-cause mortality (the reference group) is associated with a strongly significant finding of higher government mortality or other adverse events (with a magnitude more than twice that found for heart-disease studies comparing for-profits to not-for-profits). Studies of heart conditions (22% on mortality and 11% on adverse outcomes) found higher rates of adverse events in government hospitals, although the quality gap is smaller (adding the coefficient to the reference group/constant of 0.046 yields about 0.023). Studies of all-cause patient outcomes other than mortality find essentially no difference between private not-for-profit and government hospitals.

The second set of meta-regressions reported in Exhibit 4 examines the proportion of heterogeneity explained by different studies' level or unit of analysis. For comparisons of private hospitals, the estimated constant term indicates no statistically significant difference between not-for-profits and for-profits for the 29% of studies with patient-level analyses, the reference group. Hospital-level analyses yield a point estimate of worse for-profit quality, but

the coefficient does not reach statistical significance at conventional levels. The remaining 40% of studies utilize both patient- and hospital- level analyses. This category refers to studies in which the hospital-level dependent variable is constructed from a regression using patient-level data, to control for confounding from patient demographics. Such combined-level analyses find worse for-profit quality, with the same point estimate as for hospital-level analyses, now statistically significant at the 10% level.

Patient-level analyses also suggest no statistically significant difference between not-for-profit and government hospitals, whereas hospital-level analyses find government hospitals associated with higher mortality and other adverse events. Studies using a combination of patient- and hospital-level data also find government hospitals associated with lower quality; this latter effect is significant at the 2% level, but about half the magnitude of the hospital-only analyses, indicating that both-level analyses find less of a quality gap between government hospitals and not-for-profits than hospital-level analyses do.

The third set of meta-regressions test the hypothesis that differences in patient follow-up period explain heterogeneity of study results. Studies of mortality usually specify whether patient follow-up was only in-hospital or was all-location (e.g., linking patients to death certificates) for a specific period of time, such as 30 days post-admission. Studies of other adverse events seldom report when the adverse event occurs. For private hospitals, none of these categories are associated with a statistically significant difference between private not-for-profits and for-profits.

For studies including a comparison of private not-for-profit and government hospitals, the 56% of studies using in-hospital and unspecified period of patient follow-up find government

hospitals associated with significantly higher mortality and rates of other adverse events. Studies examining other categories of patient follow-up do not differ statistically from that result.

In the next panel, we test our hypothesis that data sources might explain a significant proportion of between-study heterogeneity. Studies using the National Long Term Care Survey find not-for-profits associated with lower quality than for-profits. Studies using Medicare or other data sources tend to find no statistically significant difference between private not-for-profits and for-profits. For private not-for-profit and government hospitals, the 72% of studies using Medicare claims are associated with findings of lower quality in government-owned hospitals, although the difference is not statistically significant at conventional levels.

In testing the hypothesis for co-morbidity adjustment, we find that the one-third of studies with no co-morbidity information find statistically significant higher rates of mortality and other adverse events in for-profit hospitals. By contrast, the two-thirds of studies that explicitly control for confounding from patient co-morbidities are associated with no statistically significant difference between not-for-profits and for-profits. Studies comparing private not-for-profit and government hospitals find government hospitals associated with higher mortality and rates of other adverse events, with an even larger quality gap in the half of studies that adjust for co-morbidities. Note that including patient co-morbidity information is positively correlated with some weakness in study design—most of these are studies that examined only in-hospital or unspecified patient follow-up period and have data only from the 1980s. Differences in covered periods also explain some heterogeneity; more recent data is generally associated with fewer ownership differences in patient outcomes. For private hospitals, a meta-regression reveals that studies using data only from the 1980s and studies that use data spanning the 1980s and 1990s consistently report lower for-profit quality. The 35% of studies using data from the 1990s

forward are associated with virtually no difference between private not-for-profits and for-profits, although that coefficient is only borderline significant at conventional levels.

Among studies that included government hospitals, studies using data only from the 1980s find higher mortality and rates of other adverse events in government hospitals (0.021 + 0.032 = 0.053, about the same magnitude as that associated with hospital-level analyses). Studies spanning the 1980s and 1990s find a smaller quality gap (by about 50%), and studies using 1990s or more recent data do not differ statistically from those spanning the 1980s and 1990s.

Overall, these study features explain a substantial portion of the heterogeneity across studies (as measured by the I-squared). We also examined whether disciplinary focus or publication outlet helps to explain divergent study findings. A meta-regression found no statistically significant differences in standardized effect sizes of studies published in medical journals (38%), economics journals (33%), or policy journals (29%). There were also no statistically significant differences among regions covered in the patient outcome studies. Finally, we found no systematic differences in estimated ownership effects between studies that did and did not examine ownership conversions. (All meta-regression results are available from the authors upon request.)

Explaining Variation in Studies Examining Unprofitable Care

Fewer of our hypothesized factors explain a significant proportion of between-study variation in studies of unprofitable care. Exhibit 5 presents results from the three sets of meta-regressions that do seem to have some explanatory power for understanding diverse findings in the literature. First consider the type of unprofitable care examined. For private hospital

comparisons, analyses of uncompensated care find for-profits provide less, and analyses of unprofitable services or broader measures of community benefits do not differ significantly in their overall findings (i.e., they also find for-profits provide less). For studies including government hospitals, the one-third analyzing uncompensated care finds that government hospitals provide more than private not-for-profits (significant at the 5% level and with a magnitude of more than twice the difference among private hospitals). The other two-thirds of studies, examining unprofitable services or community benefits, are associated with a reverse effect, implying that private not-for-profits supply slightly more such services than their government counterparts.

How studies empirically account for hospital competition provides additional insight regarding diversity of study findings. About 50% of studies do not explicitly model hospital competition (although most of them do include some market characteristics as independent variables). A quarter of the studies explicitly model hospital competition either through selection models or a more sophisticated procedure to define hospital markets. About a third of the studies use panel data and employ fixed-effect or random-effect models to minimize potential estimation bias due to unobserved market heterogeneity. The second panel of Exhibit 5 shows that studies with no explicit treatment of hospital competition tend to find that for-profit hospitals provide significantly less unprofitable care than nonprofits do (-0.07; $p<0.05$). The ownership gap is much smaller when estimated by studies that model competition explicitly or use panel data estimation methods; such studies essentially find no difference between not-for-profit and for-profit hospitals in provision of unprofitable care. For studies comparing not-for-profit and government hospitals, there is no significant difference in effect sizes among these three types of

studies, partly because so few studies compare unprofitable care provided by not-for-profit and government hospitals.

Finally, the last panel of Exhibit 5 reports a meta-regression on covered regions. Studies using California data find that for-profits provide just as much if not more unprofitable care than their private nonprofit counterparts (-0.048 + 0.086=0.038). Note that this "California effect" emerges despite a positive correlation between California data and two study features associated with for-profits providing less than nonprofits: analysis of uncompensated care (compared to broader measures of community benefits) and including ownership only as a control variable (compared to ownership differences being a study's primary research question). By contrast with California, studies of Florida data find for-profits provide significantly less unprofitable care (-0.136). Almost half of studies use data that is representative of the US as a whole or is specific to other combinations of states; those studies are associated with for-profits providing significantly less unprofitable care than private not-for-profit hospitals do (-0.048). Meta-regressions using our other hypothesized explanatory variables (e.g., time period covered) find no statistically significant effects. Overall, the study features we examined explained much less of the heterogeneity across unprofitable care studies than they did for studies of patient benefits; in most cases, the I-squared is substantially higher than when we examine patient outcomes, and percentage explained compared to the null model (with no covariates) is much lower.

IV. Conclusions

We conducted a systematic review of the empirical literature since 1990 to examine what factors explain the diversity of findings regarding hospital ownership and quality of care, as well as measures of community benefits.

Our meta-regression analyses revealed several correlates of study heterogeneity. Differences in analytic methods are the most salient. For studies of patient outcomes comparing not-for-profit and for-profit hospitals, study features that can explain most of the variation in effect sizes include disease or outcome studied, whether or not the study adjusted for patient co-morbidities, and data sources. For unprofitable care, how studies handle market competition in their empirical methods, as well as regional differences, account for substantial variation in results.

Differences in the unit of analysis yield contrasting findings: patient outcomes do not statistically differ across all three ownership forms when analyses were done at the patient level, whereas hospital-level and combined-level analyses find the highest rates of mortality and other adverse events at government hospitals, lower rates at for-profits, and the lowest rates at private nonprofit hospitals. We find that studies that do not adjust for co-morbidities tend to find a bigger gap between private not-for-profits and for-profits. Including co-morbidities reduces estimates of the quality gap among private hospitals, while maintaining (or widening) the government-private nonprofit quality gap. It is important to note, however, that including patient co-morbidity information is positively correlated with in-hospital or unspecified patient follow-up period and having data only from the 1980s (and negatively correlated with a focus on heart condition outcomes, a longer-term patient follow-up period, combined patient- and hospital-level analysis, and data spanning the 1980s and 1990s). Thus, including patient co-morbidities does not necessarily represent a "gold standard" in this literature.

Studies of data from the 1980s (or spanning both the '80s and '90s) find more of a quality difference between for-profit and not-for-profit hospitals than studies using more recent data. Similarly, studies that examine data from before 1990 find the gap between private not-for-profit

and government-owned community hospitals to be substantially larger than studies that examine data from the 1990s. These results are consistent with predictions of convergence among ownership forms in the increasingly competitive environment. Part of the time-trend toward finding fewer ownership differences with more recent data can also be explained by differences in analytic methods, since more recent studies often use methods specifically developed to control for confounding from market structure and unobserved differences in patient severity.

The meta-regression allows us to disentangle regional differences in unprofitable care. Studies examining nationally representative samples, and of Florida in particular, tend to find for-profits provide less unprofitable care, whereas California for-profit hospitals seem to be providing comparable amounts as their private nonprofit counterparts.

It is also worth noting what factors do not help to explain differences in study findings. For example, we found no systematic differences in estimated ownership effects between studies that did and did not examine conversions. Similarly, regions covered explained little of the variation in studies of patient outcomes, and the time period of the data explained little variation among studies of uncompensated care and other measures of community benefits. Analyses dropping outliers[47] found fairly similar results to those reported here. (All such sensitivity analyses are available from the authors upon request.) Although methods to detect publication bias are not perfect, it is not surprising that we found no evidence of publication bias—theoretical predictions about ownership effects vary.

Our results contrast with those of the sole previous systematic review in this area.[9] Whereas we aim to explain the heterogeneity in study results, the previous study aimed to provide a single definitive answer to the question of whether quality differs in for-profit and private not-for-profit hospitals. Yet the nature of observational studies in this area severely

limits the ability of meta-analysis to achieve that goal: the studies not only are observational, but draw from overlapping samples, so that many studies include data from the same hospitals or even the same patients. Although Devereaux et al. describe their review as including "fifteen observational studies, involving more than 26,000 hospitals," there are actually fewer than 6000 hospitals in the entire US. The authors note that almost all studies draw from the same database, but do not mention that the studies therefore do not represent independent samples. Another reason for interpreting the single answer from Devereaux et al. with caution is that they use patient sample size to define confidence intervals, whereas ownership is a hospital-level characteristic. Since there are many fewer hospitals than patients, using patient sample size yields a misleadingly precise estimate of hospital-level mortality differences and tends to give the largest weight to studies with the fewest controls for confounding factors (because authors often restrict sample size specifically to remove residual confounding from case mix or market characteristics).

Our paper also has several limitations. First, the tremendous diversity of dependent variable definitions and analytic methods (e.g., dichotomous and continuous, risk differences and relative risks) preclude using a more interpretable definition of effect size that would be comparable across studies. The standardized effect size that we use provides less intuitive interpretation of the ownership effect for clinical or policy decisions. However, by the conventional Cohen standard[10], magnitudes of our effect sizes mostly fall into what is considered the "small" effect region ($r<0.10$), indicating that ownership appears to play a much less important role in influencing hospital performance than other hospital characteristics, even when it is a significant predictor. Second, although we identified far more studies than many systematic reviews do, the limited number as well as substantial collinearity among study

features preclude controlling for all the hypothesized determinants of study heterogeneity in the same meta-regression (correlation matrices among study features are included in the Appendix). Finally, we discuss here only a few key aspects of hospital performance, rather than a comprehensive overview of all potential differences by organizational form. Although we examine potential systematic differences in studies that control for market-level factors, we do not focus on market-level spillover effects among hospitals of differing ownership forms. Others have argued that such spillover effects can be very important, and that for-profit providers might substantially raise the overall "cost-effectiveness" or productivity of service delivery through such mechanisms.[11]

Policymakers and researchers seeking to interpret the literature on hospital ownership and quality of care (or community benefits) should be aware that findings differ significantly according to the analytic methods of individual studies, and that conventional methods of meta-analytic synthesis are inappropriate given the considerable overlap among studied hospitals. Moreover, there appears to be as much, if not more, heterogeneity among hospitals of the same ownership form as across ownership forms. Future research on the determinants of this variation would be useful.

Acknowledgements: The authors gratefully acknowledge funding for this research from grant #050953 under the Robert Wood Johnson Foundation's Changes in Health Care Financing and Organization (HCFO) Initiative. We thank Mantian Hu, Ania Aksan, and Pam Kum for excellent research assistance. We also thank Drs. Dena Bravata, Ingram Olkin, and our expert panel members for providing valuable comments: Drs. Kathleen Carey, Shin-Yi Chou, Leemore Dafny, Guy David, Mark Duggan, Darrel Gaskin, Martin Gaynor, Michael McCue, Jack Needleman, Michael Rosko, Joanne Spetz, Robert Town, and Kevin Volpp.

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Exhibit 1. Summary of Included Studies

Patient Outcomes

Article ID	Short-term mortality	Long-term mortality	Outcomes other than mortality	Covered region	Covered years	Number of hospitals	Number of patients	Ownership forms studied
Al-Haider1991	X			US	1984	243	N/A	N,F
Bond1999	X			US	1992	3763	N/A	N,F,G
Brennan1991			X	NY	1984	51	31429	N,F,G
Brook1990	X			13 geographic areas	1981		1171	N,F,G
Deily2004	X			FL	1999 -- 2001	416		N,F,G
Ettner2001			X	US	1990	2349	42420	N,F
Farsi2004	X		X	CA	1990 -- 1998	1522	249332	N,F*
Geweke2003	X			Los Angeles County	1989 -- 1992	114	74848	N,F,G
Gowrisankaran1999	X			3 South CA counties	1989 -- 1994	844	178972	N,F,G
Keeler1992	X			5 states	1985 -- 1986	297	6665	N,F,G
Kessler2002		X	X	MSA	1985 -- 1996	29388	1661674	N,F,G
Kuhn1994	X	X		US	1988	3782	N/A	N,F,G
Lanska1998a	X		X	US	1993	900	18510	N,F,G
Lanska2000			X	17 states	1993 -- 1994	900	1408015	N,F,G
Lee2002	X		X	US	1997	358	N/A	N,F
Manheim1992	X			US	1987	3796	N/A	N,F,G
McClellan2000b	X			US	1985, 1991, 1994	11154	>600 000	N,F,G
Mukamel2001	X			134 MSAs	1990	1927	N/A	N,F,G
Norton1998			X	US	1985 -- 1990		295473	N,F,G
Picone2002	X	X		US	1984 -- 1995	40095	73503	N,F,G*
Pitterle1994	X			US	1988	4864	N/A	N,F,G
Shen2002	X	X	X	US	1985 -- 1994	16042	2100000	N,F*
Sloan1999	X			US	1982, 1984, 1989, 1995	1378	2674	N,F,G
Sloan2001	X	X		US	1982, 1984, 1989, 1995	1378	8403	N,F,G
Sloan2002	X		X	21 states	1988 -- 1996	1215	417851	GN,F*
Sloan2003	X	X		US	1994 -- 1995		129092	N,F,G
Slonim2003			X	US	1988, 1991, 1994, 1997	759	2483216	N,F,G
Taylor1999	X			US	1982, 1984, 1989, 1995	1378	2674	N,F,G
Unruh2000	X		X	PA	1991--1997	1477	13257906	N,F
Wan1992			X	VA	1987	85	N/A	N,F
Yuan2000	X			US	1984 -- 1993	5127	N/A	N,F,G
Total	**24**	**6**	**13**					

Unprofitable Care (Uncompensated Care, Unprofitable Services, and/or Community Benefits)

article ID	Uncom-pensated Care	Unprofit-able Services	Community Benefits	Covered region	Covered years	Number of hospitals	Number of patients	Ownership forms studied
Campbell1993	X			CA	1983, 1987	311	N/A	N,F,G
Clement2002	X			CA	1996	350	N/A	N,F,G
Currie2004		X		CA	1988 -- 1996	3528	N/A	N,F,G
Kwon1999	X			MO	1992	123	N/A	N,F
Molinari1993	X			CA	1985	188	N/A	N,F,G
Needleman1999	X			FL	1981 -- 1996	2728	N/A	N,F,G*
Norton1994		X		US	1981	3322	N/A	N,F
Potter2001		X		US	1980, 1985, 1990, 1994	19444	N/A	N,F,G
Proenca2003			X	US	1997	3453	N/A	N,F
Shen2003b		X		US	1987 -- 1998	8915	N/A	N,F,G*
Shukla1997			X	VA	1993	83	N/A	N,F
Thorpe2000	X	X		US	1990 -- 1997	431	N/A	N,F,G*
Thorpe2001	X			MSA	1991 -- 1997	21000	N/A	N,F,G
Young1999	X	X		CA, FL, TX	1978 -- 1995	1368	N/A	N,F*
Zeckhauser1995	X			CA, FL	1982, 1990	908	N/A	N, F, G
Total	**9**	**6**	**2**					

Notes:
MSA=metropolitan statistical areas; N/A=Not available
* Studies of ownership conversion

Exhibit 2. Summary of Effect Sizes For Patient Outcomes

2A. Studies Comparing Not-For-Profit and For-Profit Hospitals

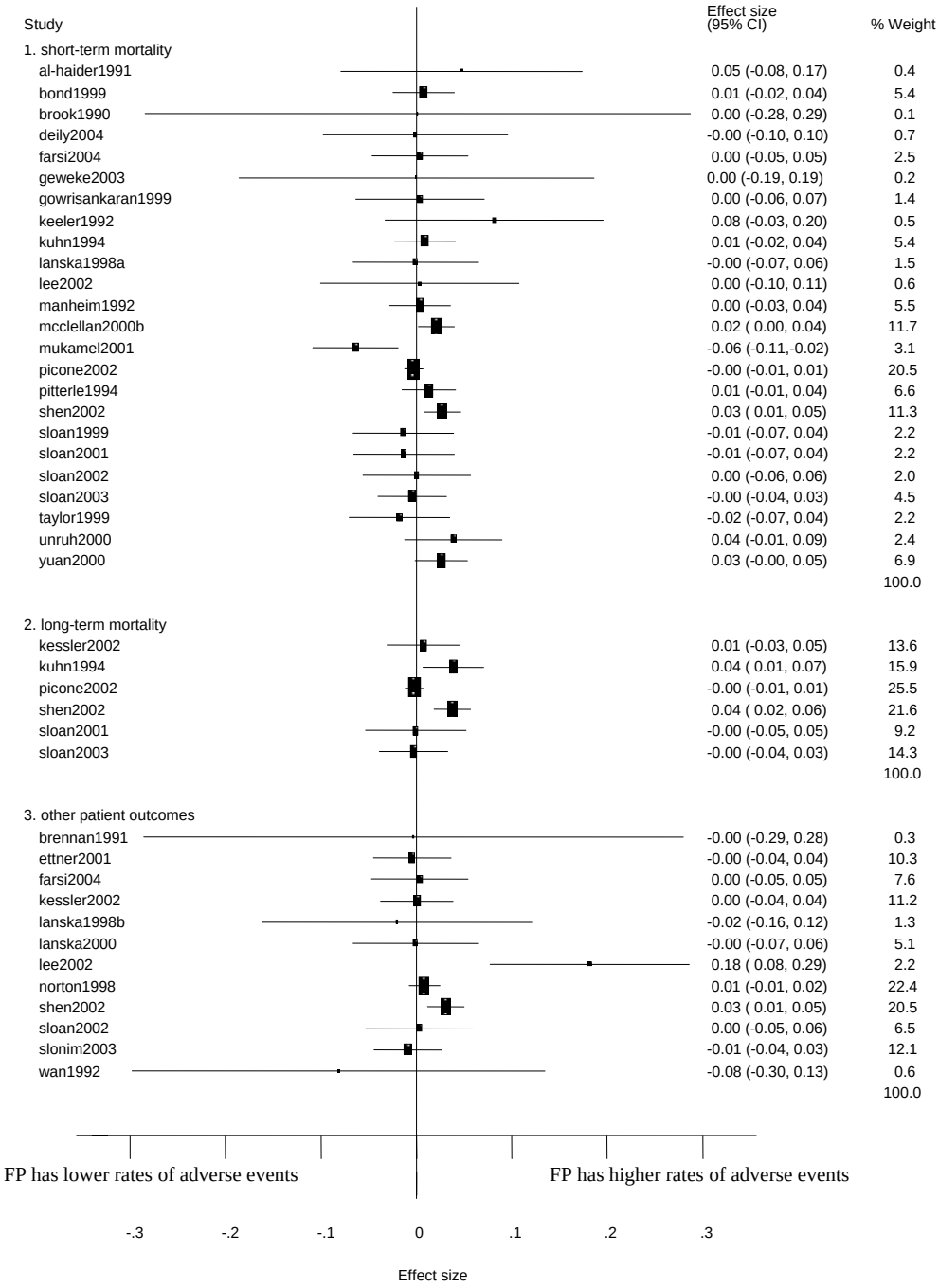
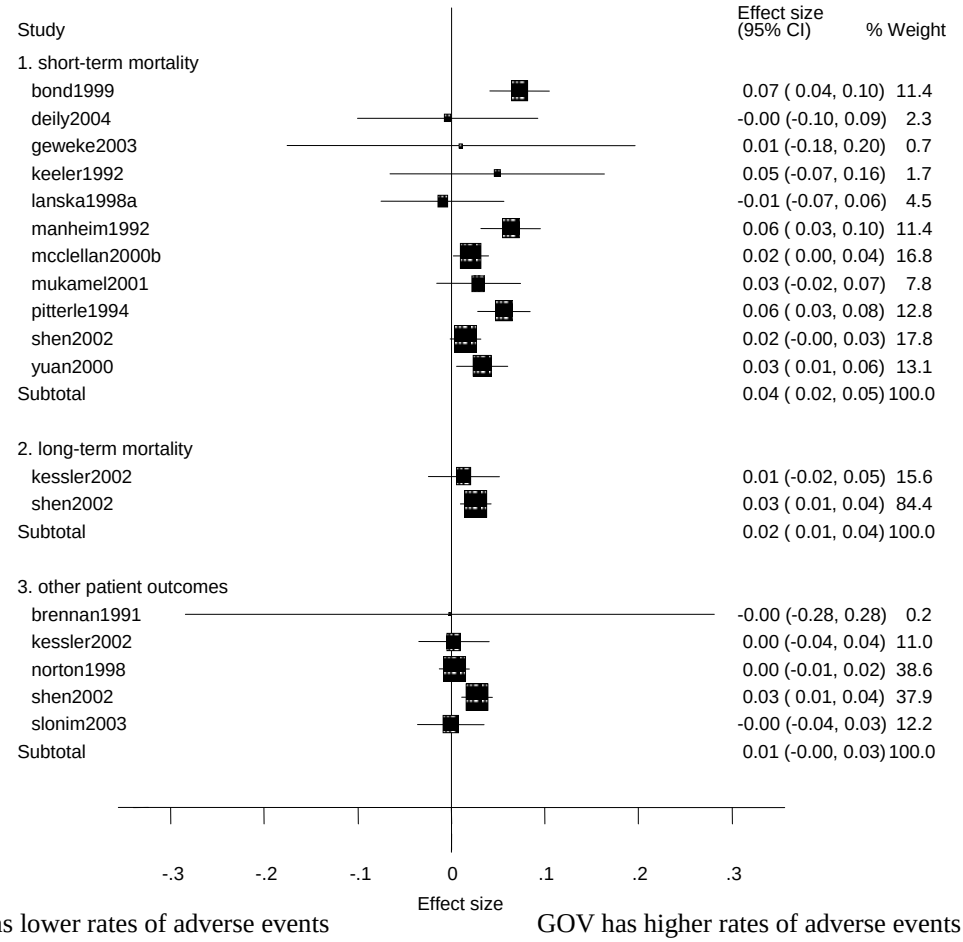


Exhibit 2B. Studies Comparing Outcomes at Not-For-Profit and Government Hospitals



GOV has lower rates of adverse events GOV has higher rates of adverse events

Exhibit 3. Summary of Effect Sizes For Unprofitable Care
3A. Studies Comparing Not-For-Profit and For-Profit Hospitals

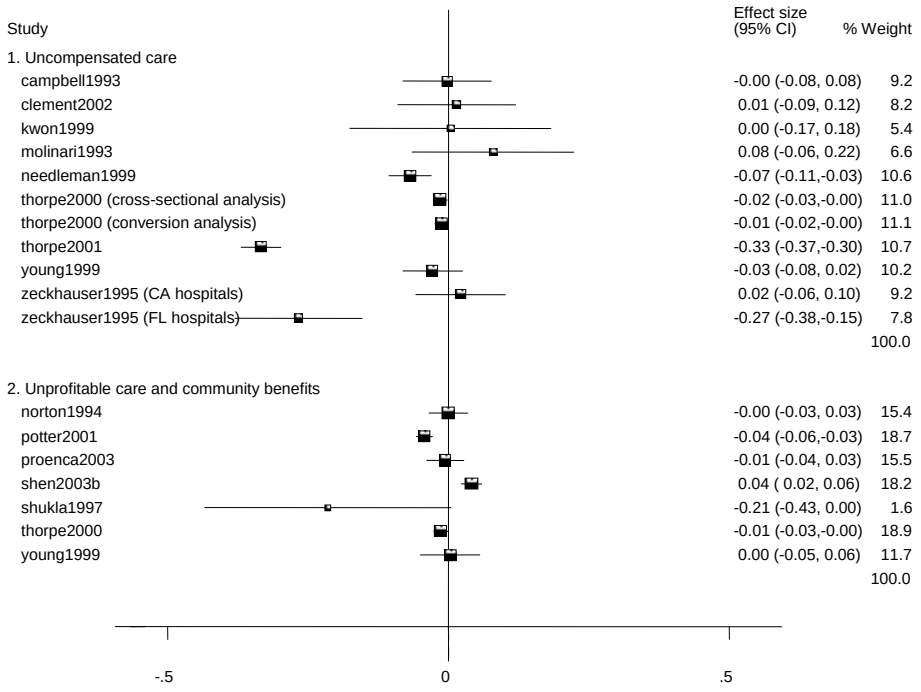


Exhibit 3B. Studies Comparing Not-For-Profit and Government Hospitals

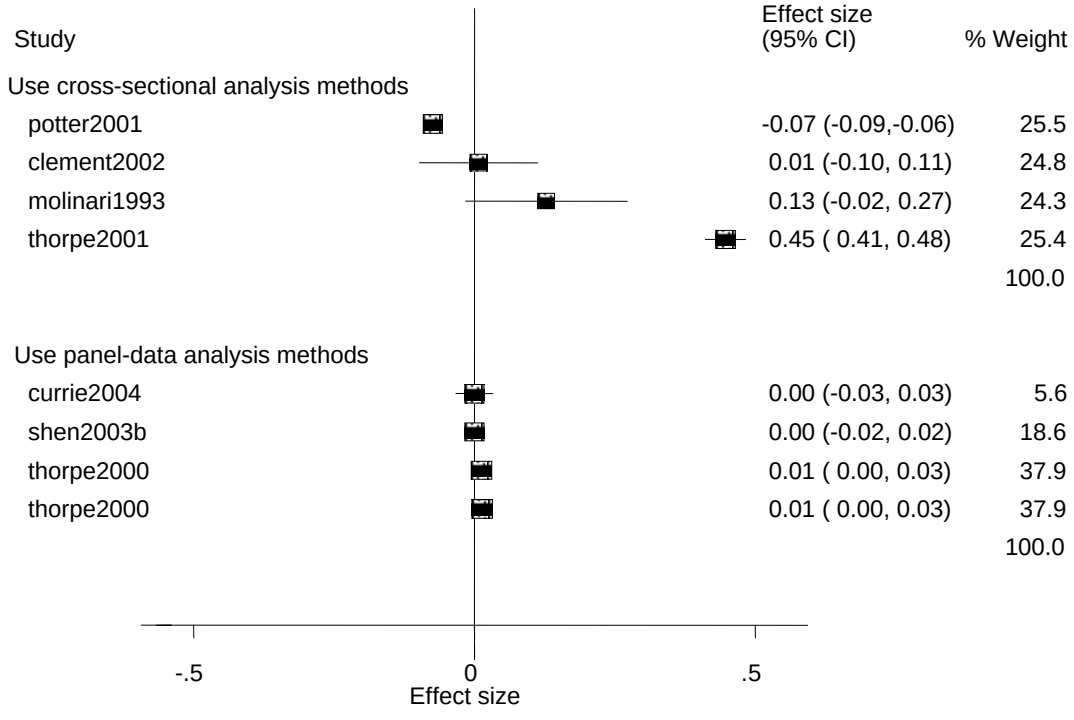


Exhibit 4. Meta Regression Results: Variation in Studies Examining Patient Outcomes

	For-profits Compared to Nonprofits			Government Compared to Nonprofits		
Study Features	Share of Studies With Given Study Feature	Coefficient	Standard Error	Share of Studies With Given Study Feature	Coefficient	Standard Error
Type of outcome						
All-cause mortality (reference group)	48%	0.003	0.004	50%	0.047 **	0.008
Heart-condition mortality	24%	0.017 **	0.006	22%	-0.024 **	0.009
All-cause patient outcomes other than mortality	21%	0.003	0.008	17%	-0.045 **	0.012
Heart-condition outcomes other than mortality	7%	0.020 *	0.009	11%	-0.023 *	0.012
Proportion of variation due to heterogeneity (I-square)			0.083			0.00
Level of analysis						
Patient-level analysis (reference group)	29%	-0.001	0.007	22%	0.002	0.007
Hospital-level analysis	31%	0.015	0.010	33%	0.048 **	0.010
Both patient- and hospital-level	40%	0.016 *	0.008	44%	0.023 **	0.009
Proportion of variation due to heterogeneity (I-square)			0.24			0.00
Patient follow-up period						
In-hospital and unspecified (reference group)	60%	0.003	0.006	56%	0.030 **	0.008
Short-term not including in-hospital (<180 days)	19%	0.011	0.008	22%	-0.007	0.012
Long-term (>= 180 days)	21%	0.014	0.008	22%	-0.006	0.012
Proportion of variation due to heterogeneity (I-square)			0.26			0.43
Data sources						
Other data sources (reference group)	26%	0.004	0.007	28%	-0.002	0.016
Medicare claims	60%	0.014	0.008	72%	0.030	0.017
National Long Term Care Survey	14%	-0.021 **	0.005	0%		
Proportion of variation due to heterogeneity (I-square)			0.00			0.35
Risk adjustment with patient co-morbidities						
No comorbidity information (reference group)	33%	0.020 **	0.004	50%	0.019 **	0.006
Study includes comorbidity information	67%	-0.017 **	0.005	50%	0.020 *	0.010
Proportion of variation due to heterogeneity (I-square)			0.07			0.39
Covered period						
Data from 1980s and 1990s (reference group)	43%	0.014 **	0.004	50%	0.021 **	0.005
Data from 1980s only	22%	0.003	0.010	24%	0.032 **	0.013
Data from 1990s only	35%	-0.014	0.008	26%	0.009	0.013
Proportion of variation due to heterogeneity (I-square)			0.24			0.24
Number of observations			50			26

* p<0.10 ** p<0.05

Note: Each panel represents a separate regression; a positive coefficient indicates that for-profit (or government) hospitals are associated with a higher level of that dependent variable than private not-for-profit hospitals. The significance test was obtained using the permutation test approach in Higgens and Thompson (2004) to avoid spurious findings. The I2 for the null model with no covariates is 0.252 for studies comparing nonprofits and for-profits, and 0.405 for studies comparing nonprofits and government hospitals.

Exhibit 5. Meta Regression Results: Variation in Studies Examining Unprofitable Care

	For-profits Compared to Nonprofits			Government Compared to Nonprofits		
Study Features	Share of Studies With Given Study Feature	Coefficient	Standard Error	Share of Studies With Given Study Feature	Coefficient	Standard Error
Type of study						
Uncompensated care (reference group)	56%	-0.061 **	0.028	33%	0.156 **	0.062
Unprofitable services or community benefits	44%	0.043	0.039	67%	-0.191 **	0.075
Proportion of variation due to heterogeneity (I-square)			0.94			0.98
Type of estimation model						
No explicit model of market competition nor panel estimation (reference group)	52%	-0.077 **	0.026	50%	0.044	0.063
Explicit modeling for market competition	24%	0.073 *	0.043	25%	-0.020	0.113
Use panel data estimation	32%	0.052	0.038	42%	-0.030	0.099
Proportion of variation due to heterogeneity (I-square)			0.92			0.99
Covered region						
US representative and others (reference group)	48%	-0.048 **	0.023	75%	0.020	0.051
California	32%	0.086 *	0.042	25%	0.021	0.105
Florida	20%	-0.089 *	0.048	0%		
Proportion of variation due to heterogeneity (I-square)			0.94			0.99
Number of observations			25			12

* p<0.10 ** p<0.05

Note: Each panel represents a separate regression; a positive coefficient indicates that for-profits (or government) are associated with a higher level of that dependent variable than private not-for-profit hospitals. The significance test was obtained using the permutation test approach in Higgens and Thompson (2004) to avoid spurious findings. The I2 for the null model with no covariates is 0.938 for studies comparing nonprofits and for-profits, and 0.985 for studies comparing nonprofits and government hospitals.

Appendix A1. Correlation Matrix of Study Features For Outcome Studies

Studies comparing NFP and FP	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. All-cause mortality	1.00															
2. Heart-condition mortality	-0.53	1.00														
3. All-cause patient outcomes other than mortality	-0.50	-0.29	1.00													
4. Heart-condition outcomes other than mortality	-0.26	-0.16	-0.14	1.00												
5. In-hospital and unspecified	0.20	-0.45	0.31	-0.15	1.00											
6. Short-term not including in-hospital (<180 days)	0.02	0.30	-0.25	-0.13	-0.59	1.00										
7. Long-term (>= 180 days)	-0.27	0.25	-0.13	0.31	-0.63	-0.25	1.00									
8. Patient-level analysis	-0.60	0.27	0.44	0.03	-0.12	-0.04	0.18	1.00								
9. Hospital-level analysis	0.50	-0.37	-0.10	-0.19	0.24	-0.06	-0.22	-0.42	1.00							
10. Both patient- and hospital-level	0.09	0.11	-0.31	0.15	-0.11	0.09	0.04	-0.52	-0.55	1.00						
11. Medicare claims	0.11	0.12	-0.28	0.04	-0.48	0.28	0.31	-0.12	0.13	-0.01	1.00					
12. National Long Term Care Survey	0.16	0.09	-0.21	-0.11	-0.22	0.15	0.12	0.04	-0.27	0.22	0.34	1.00				
13. Study includes comorbidity information	0.07	-0.08	0.12	-0.20	0.24	-0.04	-0.25	0.22	0.15	-0.34	-0.17	0.14	1.00			
14. Data from 1980s and 1990s	-0.06	0.19	-0.22	0.13	-0.36	0.19	0.25	-0.12	-0.48	0.56	0.32	0.47	-0.31	1.00		
15. Data from 1980s only	0.18	-0.16	0.04	-0.15	0.09	0.03	-0.14	-0.05	0.39	-0.32	0.29	-0.22	0.10	-0.46	1.00	
16. Data from 1990s only	-0.10	-0.06	0.19	-0.01	0.30	-0.23	-0.14	0.17	0.15	-0.30	-0.59	-0.30	0.23	-0.64	-0.39	1.00
Studies comparing NFP and GOV	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. All-cause mortality	1.00															
2. Heart-condition mortality	-0.53	1.00														
3. All-cause patient outcomes other than mortality	-0.45	-0.24	1.00													
4. Heart-condition outcomes other than mortality	-0.35	-0.19	-0.16	1.00												
5. In-hospital and unspecified	0.45	-0.60	0.40	-0.40	1.00											
6. Short-term not including in-hospital (<180 days)	0.00	0.36	-0.24	-0.19	-0.60	1.00										
7. Long-term (>= 180 days)	-0.53	0.36	-0.24	0.66	-0.60	-0.29	1.00									
8. Patient-level analysis	-0.53	-0.29	0.84	0.24	0.21	-0.29	0.04	1.00								
9. Hospital-level analysis	0.71	-0.38	-0.32	-0.25	0.40	-0.09	-0.38	-0.38	1.00							
10. Both patient- and hospital-level	-0.22	0.60	-0.40	0.04	-0.55	0.33	0.33	-0.48	-0.63	1.00						
11. Medicare claims	-0.12	0.33	-0.39	0.22	-0.55	0.33	0.33	-0.27	0.18	0.06	1.00					
12. National Long Term Care Survey																
13. Study includes comorbidity information	0.56	-0.53	0.15	-0.35	0.45	0.00	-0.53	0.00	0.47	-0.45	-0.12		1.00			
14. Data from 1980s and 1990s	-0.56	0.53	-0.15	0.35	-0.67	0.27	0.53	0.00	-0.47	0.45	0.37		-0.33	1.00		
15. Data from 1980s only	0.23	-0.30	0.19	-0.20	0.23	0.02	-0.30	0.10	0.16	-0.23	-0.02		0.49	-0.56	1.00	
16. Data from 1990s only	0.41	-0.32	-0.01	-0.21	0.54	-0.32	-0.32	-0.09	0.38	-0.28	-0.40		-0.09	-0.60	-0.33	1.00

Appendix A2. Correlation Matrix of Study Features For Unprofitable Care Studies

Studies comparing NFP and FP	1	2	3	4	5	6
1. Uncompensated care	1.00					
2. Unprofitable care	-1.00	1.00				
3. Explicit model of hospital competition	-0.07	0.07	1.00			
4. Use panel data estimation methods	-0.08	0.08	0.02	1.00		
5. California study	0.44	-0.44	0.22	-0.10	1.00	
6. Florida study	0.24	-0.24	-0.28	0.30	0.09	1.00
Studies comparing NFP and GOV	1	2	3	4	5	6
1. Uncompensated care	1.00					
2. Unprofitable care	-1.00	1.00				
3. Explicit model of hospital competition	0.00	0.00	1.00			
4. Use panel data estimation methods	-0.24	0.24	0.29	1.00		
5. California study	0.41	-0.41	0.11	-0.10	1.00	
6. Florida study						