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THE EFFECTS OF HOSPITAL OWNERSHIP ON MEDICAL PRODUCTIVITY

Daniel Kessler
Mark McClellan

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ABSTRACT

To develop new evidence on the effects of hospital ownership and other aspects of hospital market composition on health care productivity, we analyze longitudinal data on the medical expenditures and health outcomes of the vast majority of nonrural elderly Medicare beneficiaries hospitalized for new heart attacks over the 1985-1996 period. We find that the effects of ownership status are quantitatively important. Areas with a presence of for-profit hospitals have approximately 2.4 percent lower levels of hospital expenditures, but virtually the same patient health outcomes. We conclude that for-profit hospitals have important spillover benefits for medical productivity.

Daniel Kessler
Graduate School of Business
Stanford University
Stanford, CA 94305
and NBER
fkessler@stanford.edu

Mark McClellan
Council of Economic Advisors
17th and Pennsylvania Avenue, NW
Washington, DC 20502
and NBER
markmc@stanford.edu

Introduction

The social welfare implications of for-profit versus non-profit ownership, and private versus public ownership, have been of interest to economists for decades. In stylized microeconomic models of organizations, theory predicts that the for-profit organizational form is efficient, because of the high-powered incentives that arise from the presence of a well-defined residual claimant with legally enforceable property rights. In an early work, however, Arrow (1963) observed that non-profit organizations may be a socially-optimal response to incomplete markets. Although this line of research has been developed extensively (e.g., Nelson and Krashinsky 1973; Easley and O'Hara 1983; Hansmann 1980, 1987, 1996; Rose-Ackerman 1996; Weisbrod 1977, 1988), other theoretical work has shown that the non-profit form may be socially inferior or equivalent to the for-profit form, even if markets are incomplete (e.g., Newhouse 1970, Feldstein 1971, Pauly and Redisch 1973).

This theoretical indeterminacy has translated into a long-standing policy debate in health economics about the welfare implications of for-profit, private non-profit, and public ownership, particularly ownership of hospitals (see Sloan 1997 for a comprehensive overall review; see Hamilton 1994 and Philipson 1997 for discussion of the impact of ownership status in the context of nursing homes). Researchers exploring the effects of for-profit, private non-profit, and public hospital ownership on medical productivity have reported a wide range of empirical results. On one hand, some researchers report that the for-profit form achieves greater productive efficiency (e.g., Wilson and Jadlow 1982, Herzlinger and Krasker 1987, Cutler and Horwitz 2000). On the other hand, many studies find that for-profit hospitals have higher costs or markups than do non-profits (e.g., Lewin et al. 1981, Coelen 1986, Ettner and Hermann 1997, Pattison and Katz 1983, Pattison 1986, Zuckerman et al. 1994), that for-profit hospitals offer lower quality (Hartz et al. 1989, Mark 1996), or that for-profit hospitals supply less uncompensated or charity care (Frank, Salkever, and Mitchell 1990, Norton and Staiger 1994, Mann et al. 1995; but see Sloan and Vraiciu 1983 and Young, Desai, and Lukas 1997). And, a substantial literature argues that non-profit hospitals have costs and/or quality similar to that of for-profits, concluding that hospitals are socially indistinguishable on the basis of ownership status (e.g., Sloan and Vraiciu 1983, Becker and Sloan 1985, Gaumer 1986, Shortell and Hughes 1988, Keeler et al. 1992, Patel, Needleman, and Zeckhauser 1994, Sloan et al. 1998, McClellan and Staiger 2000, Duggan 2000a).

The existing empirical literature has three key limitations. First, it does not generally examine *both* the financial implications and patient health consequences of hospital ownership structure; without significant additional assumptions, it is not possible to draw conclusions about the impact of ownership on productivity or welfare. Second, those studies that do seek to make welfare comparisons generally suffer from potential selection bias. If hospital ownership (or any other hospital characteristic) does affect productivity, and sicker patients (who value productivity more highly) seek out more productive hospitals, then estimates of the impact of ownership status that do not completely control for patient heterogeneity will represent a combination of the true impact and unobserved differences between patient populations. Although some work has sought to control for differences in patient populations based on measurement of observable patient characteristics, observational data on health status is notoriously incomplete, making past estimates of the impact of ownership difficult to interpret.

Third, it does not generally evaluate the spillover effects of for-profit hospitals on the practices of other types of hospitals in a market. From a policy perspective, spillover effects may be much more important than direct (own-hospital) effects because public and for-profit hospitals account for a small fraction of admissions in most markets. For example, if for-profit hospitals account for approximately 10 percent of admissions in a market, and for-profit hospitals have 5 percent higher expenditures per patient, then even a doubling of the share of for-profit hospitals' admissions would lead to health care costs that were 1 percent higher in aggregate. If hospitals of different ownership statuses engage in different types of strategic behavior, or increasing presence of for-profits results in even modest increases in efficient behavior by non-profits, then spillover effects would be much more important than the "direct" effects of for-profit hospitals on practice patterns, health care costs, and health outcomes.[1]

Our analysis addresses these limitations. We use longitudinal data on essentially all nonrural elderly Medicare recipients hospitalized for a treatment of a new heart attack over the 1985-96 period, matched with comprehensive data on all nonrural U.S. hospitals over the same period. This enables us to examine the resources used in and the health benefits of treatment for a given occurrence of illness in hospitals of different ownership. Our methods offer an alternative approach to dealing with selection bias and measuring spillover effects. As we discuss below, this approach can be used to estimate consistently the effect of any hospital characteristic. Based on a model of individual patients' demand for hospital services, we construct area-based measures of the "density" of hospitals of different ownership types -- that is, the probability that a patient residing in an area will be admitted to a hospital of a given ownership type, based only on

[1]See, for example, the discussion of the consequences for the local market of the sale of (the non-profit) Wesley Medical Center to (the for-profit) HCA in Cutler and Horwitz (2000).

arguably exogenous determinants of hospital demand. We assess the effect of ownership-type densities on medical expenditures and health outcomes, holding constant the area densities of other hospital characteristics, the competitiveness and other features of hospital markets, patient characteristics, and zip-code level fixed effects.

This approach allows us to assess the relative efficiency of ownership-induced differences in medical practice by identifying the "cost-effectiveness" of hospital organizational form, that is, the cost of an additional year of life or an additional year of cardiac health associated with different ownership forms in a market. For example, if non-profit hospitals provide lower levels of treatment intensity, without leading to any deterioration in patient health outcomes, then the non-profit form is the most productive way to organize hospital markets. If the non-profit form leads to higher levels of intensity, but not to lower levels of adverse outcomes, then the non-profit form is not a productive way to provide hospital services. If the non-profit form either increases or decreases both costs and health, then our results still provide quantitative guidance for policy. For example, if non-profits provide treatment that leads to low expenditures per year of life saved relative to for-profits, then they lead to efficient care; but if non-profits provide treatment that leads to relatively high levels of expenditures per year of life saved, then they provide incentives for socially excessive care.

Section I of the paper discusses the theoretical ambiguity of the impact of hospital ownership on medical productivity. Section II reviews the previous empirical literature on this topic. Although this literature has helped to shape understanding of markets for medical care, Section II describes its three key limitations, and how these limitations affect its assessments of the consequences of hospital ownership. Section III describes how our approach addresses these limitations, and presents our econometric models of the effects of hospital ownership on medical treatment decisions, health care costs, and health outcomes. Section IV discusses our two data sources, Section V presents our empirical results, and Section VI concludes.

I. Theoretical Models of the Impact of Hospital Ownership

In simple microeconomic models of organizations, theory predicts that the for-profit organizational form leads to efficient production, because of the high-powered incentives that arise from the presence of a well-defined residual claimant with enforceable property rights. However, markets for health care in general, and markets for hospital services in particular, deviate substantially from the assumptions behind this model. For this reason, there is an extensive theoretical literature examining the welfare implications of hospital ownership status.

One line of research, starting with Arrow (1963), hypothesizes that market failures in health care can lead the non-profit organizational form to be socially superior. At the base of these models is the assumption that non-profits either do not or can not pursue an objective of pure profit maximization (for a general review, see Rose-Ackerman 1996). Because of this constraint, non-profits might address contract failures in the presence of informational asymmetries between consumers and producers (e.g., Nelson and Krashinsky 1973; Easley and O'Hara 1983; Hansmann 1980, 1987, 1996). In markets for health care services, for-profit firms may have both the incentive and the opportunity to take advantage of customers by providing less service to them than was promised, or more costly services than would be desired by a well-informed, paying consumer. A private non-profit or publicly-owned firm, in contrast, may offer consumers the advantage that those who control the firm either do not or can not pursue pure profit maximization. Thus, physicians and managers of public or private non-profit hospitals may have less incentive and/or ability to take advantage of patients than do their counterparts at for-profit hospitals. Alternatively, private non-profit hospitals might serve as an extragovernmental means to satisfy residual demand for public health services, if hospital markets have public good aspects (Weisbrod 1977, 1988). Specifically, if governments support public goods only at the level demanded by the median voter, then non-profits may arise to supplement public provision of public goods in areas with above-median demand.

Another line of research shares the assumption that non-profits pursue different objectives than do for-profits, but concludes that the non-profit form may be socially inferior to the for-profit form. Newhouse (1970), for example, models non-profit hospitals as maximizing quantity and quality of treatment subject to a zero-profit constraint. Non-profit hospitals are able to behave in this fashion both because the government gives tax benefits to non-profit providers of health care services, and because health-insurance and tax incentives make consumers of medical care relatively insensitive to price. The welfare implications of a Newhouse-type model are in general ambiguous. On one hand, if the additional quantity and quality of treatment attributable to the non-profit form results in the provision of additional treatments with expected value greater than cost, then non-profit hospitals may increase efficiency, even if their treatments are more expensive. On the other hand, if quality maximization leads to marginal treatment that results in high expenditures per year of life saved, then the non-profit form provides socially excessive care.

Other work has pointed out that there is no definitive relationship between ownership status and social welfare, even if both non-profit and for-profit hospitals seek to maximize revenues less costs. Pauly and Redisch (1973) model the formation of non-profit hospitals' strategy directly, hypothesizing that non-profit hospitals behave as cooperatives controlled by physicians, operated to maximize physicians' private benefit. As they observe, this model is consistent with the supply of socially excessive quality by non-profit hospitals. If "quality" is produced through the application of nonphysician labor and capital, then noncooperative behavior among controlling physicians could lead to rent dissipation that took the form of high quality. An alternative implication of this approach (e.g., Becker and Sloan 1985) is that non-profit hospitals may have costs and quality similar to that of for-profits, if doctors monitor the efficiency of non-profit hospitals just as effectively as do equity-holders in a for-profit enterprise.

These models also highlight the fact that there may be important spillover effects of hospital ownership. For example, in markets with a high density of for-profit hospitals, non-profits may be less able either to provide social benefits or impose social costs (described by Kennedy (1985) as the "proprietorization of voluntary hospitals"). Alternatively, if they face competition from for-profits, they may be more likely to emulate for-profit behavior, for example by exploiting loopholes in Medicare reimbursement (e.g., Cutler and Horwitz 2000).

II. Previous Empirical Literature

The theoretical debate over the effect of hospital ownership structure on medical productivity and social welfare has spawned a vast empirical literature that includes results consistent with a wide range of theoretical models. One reason for the empirical literature's indeterminacy – indeed, its main shortcoming – is that many of the studies do not assess directly both the financial implications and patient health consequences of hospital ownership structure.

Much of the literature analyzes the impact of ownership status on staffing, spending, costs, charges, or price/cost markups (Lewin 1981, Wilson and Jadlow 1982, Pattison and Katz 1983, Sloan and Vraiciu 1983, Becker and Sloan 1985, Coelen 1986, Pattison 1986, Watt et al. 1986, Grosskopf and Valdmans 1987, Herzlinger and Krasker 1987, Patel, Needleman, and Zeckhauser 1994, Zuckerman et al. 1994, Kao 1998). However, without information on differences in patient health outcomes (e.g., output) by ownership status, these studies can not draw conclusions about the impact of ownership on medical productivity without significant additional assumptions. Conversely, several other studies focus only on the effect of ownership on outcomes, but not on the effect of ownership on resource use (Gaumer 1986, Shortell and Hughes 1988, Hartz et al. 1989, Keeler et al. 1992, McClellan and Staiger 2000). Other research is concerned with the effect of hospital ownership and the interaction between hospital market structure and ownership on the provision of public goods such as care for the poor (e.g., Sloan and Vraiciu 1983; Frank, Salkever, and Mitchell 1990; Norton and Staiger 1994; Mann et al. 1995; Young, Desai, and Lukas 1997; Duggan 2000a, 2000b; Frank and Salkever 2000), and so does not address the issue of how ownership status affects welfare through productivity.

Some recent studies use data on individual patients admitted to the hospital to measure the impact of the ownership status of patients' hospital of admission on both the inputs and the outputs of the medical care production process (Mark 1996, Sloan et al. 1998). These studies suffer from another important shortcoming: possible selection bias. If hospital ownership (or any other hospital characteristic) does affect productivity, and sicker patients (who value productivity more highly) seek out more productive hospitals, then estimates of the impact of ownership status that do not completely control for patient heterogeneity will represent a combination of the true impact and unobserved differences between hospitals' patient populations. Although the studies have sought to correct for selection bias by controlling for measures of patient demographic characteristics and pre-admission comorbidity and functionality in their estimation of the impact of ownership status, observational data on health status is notoriously incomplete, making estimates of the impact of ownership difficult to interpret. Ettner and Hermann (1997) address this concern with instrumental variables techniques, and examine the effect of hospital ownership on Medicare charges and costs for a given psychiatric admissions, and the effect of ownership on the probability of readmission and mode of discharge.

Still, none of this work has focused on the spillover or market-level effects of ownership. Silverman, Skinner and Fisher (1999) compare the growth of Medicare expenditures between 1989-95 in "hospital service areas" (HSAs) characterized by complete for-profit versus non-profit ownership, and find significantly more rapid expenditure growth in for-profit areas. However, they do not examine the outcome consequences of differences in spending growth. And, since most HSAs contain only one hospital, their study also may not capture all spillover effects. In the limit, if every HSA contained only one hospital, then differences between for-profit and non-profit HSAs would be equivalent to own-hospital differences.

III. Models

We offer an alternative approach to dealing with selection bias that also measures spillover effects, and thus provides a more complete assessment of the market-level consequences of hospital ownership for medical productivity. As we describe in more detail in the next section, we analyze longitudinal data on essentially all nonrural elderly Medicare recipients hospitalized for a treatment of a new heart attack over the 1985-96 period, matched with comprehensive data on all nonrural U.S. hospitals over the same period. To avoid the problems of prior studies in obtaining accurate estimates of the effects of ownership structure, we use a three-stage method. The core idea of our method is to develop an explicit model of the demand for hospital services based on exogenous factors such as travel distances, and then to use this model as a basis for the construction of exogenous measures of patient flows to hospitals of different ownership statuses and other broad types. This approach allows us to assess the impact of ownership status, holding other hospital characteristics constant, while avoiding the major empirical obstacles in previous studies of ownership described in Section II. In addition, our data permit a thorough evaluation of the consequences of ownership and other hospital characteristics for the medical expenditures and outcomes associated with a given episode of care.

In stage one, we specify and estimate patient-level hospital choice models as a function of exogenous characteristics of the patient, the geographic area, and all of the nearby hospitals, along the lines of Kessler and McClellan (2000).[2] Estimates from these models provide for each patient the probability of admission to every nearby hospital, based only on exogenous factors. We model the extent to which hospitals with various characteristics -- for-profit, private non-profit, or public ownership; size, in terms of the number of beds; teaching status; and system membership status – at various distances from each patient's residence affect each patient's

[2]We define "nearby" to include all nonfederal, general medical /surgical hospital within 35 miles of the patient's residence with at least five AMI admissions, and any large, nonfederal, general medical/surgical teaching hospital within 100 miles of the patient's residence with at least five AMI admissions. (We explain the reason for these *a priori* constraints on patients' choices below; because markets for cardiac care are generally much smaller than the constraints, they are not restrictive.)

hospital choice, and we also allow each patient's demographic characteristics to affect her likelihood of choosing hospitals of one type over another.

In stage two, we use this vector of probabilities in two ways. First, we use the vector of probabilities to construct area-based measures of the "density" of admissions to hospitals with different characteristics, including ownership type. We calculate the probability of each individual's admission to hospitals of different sizes and different ownership, teaching, and system membership statuses, based only on exogenous factors. Weighted sums of these probabilities define the density of admissions to hospitals of each type in every non-rural zip code of patient residence in the country. The calculation of the probabilistic-admission-weighted densities of hospital characteristics is described in Kessler and McClellan (2000).

Second, we use the vector of probabilities to construct the exogenous patient zip-code measures of market competitiveness and capacity utilization described in Kessler and McClellan (2000). Because hospital ownership status may be correlated or interact with hospital market structure, simply examining the unconditional average effect of hospital ownership status on decision-making may lead to biased assessments of the effect of ownership, and may mask important differences in the impact of ownership in different market environments (e.g., Dranove 1988, Kopit and McCann 1988, Lynk 1995).

Stage three of our method estimates the effect of the area density of hospital ownership status, the density of other hospital characteristics, and hospital market structure on Medicare hospital expenditures in the year after the individual's admission for a new heart attack and on several important measures of patient health outcomes.[3] These models provide a consistent estimate of the sum of the strategic and the area-average direct effects, holding constant the area average density of other characteristics, regardless of the correlation between unobserved determinants of patient health status and hospital characteristics.

We assess the impact of ownership on hospital expenditures and health outcomes, using longitudinal data on cohorts of elderly Medicare beneficiaries with heart disease from 1985-1996. We use zip-code fixed effects to control for all time-invariant heterogeneity across small geographic areas, hospitals, and patient populations; our estimates of the effect of ownership are identified using *changes* in hospital markets. In addition, we include time-fixed effects that are allowed to vary by size of geographic area, and include controls for time-varying characteristics of geographic areas (such as the travel distance between individuals' residence and their closest hospital), to address the possibility that our estimated effects of ownership are due to still other omitted factors that were correlated with health care costs, health outcomes, and hospital markets.

In zip code k during year t = 1,. . ., T observational units in our analysis consist of individuals i=1,. . ., N_{kt} who are initially admitted to hospital j with new occurrences of particular illnesses such as a heart attack. Each patient has observable characteristics U_{ikt}: four age

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[3]Ideally, we would like to identify separately three theoretically distinct ownership status effects: the direct effect of an individual's initial hospital of admission, the direct effect of an individual's subsequent hospital(s) of admission, and the (spillover) effects of other area hospitals. However, our principal source of exogenous variation in hospital demand – differential distances between patients' residences and different types of hospitals – is not sufficient to distinguish between the direct effects of an individual's several hospitals' ownership statuses and area-based spillover effects. Interactions between area-based instruments and individual patient characteristics are theoretically sufficient to separate direct from strategic effects; but in practice, these interactions have very little power.

indicator variables (70-74 years, 75-79 years, 80-89 years, and 90-99 years; omitted group is 65-69 years), gender, and black/nonblack race; plus a full set of interaction effects between age, gender, and race; and interactions between year and each of the age, gender, and race indicators. The individual receives treatment of aggregate intensity R_{ikt}, where R is total hospital expenditures in the year after the health event (we also examine the effects of ownership on the components of R). The patient has a health outcome O_{ikt}, possibly affected by the intensity of treatment received, where a higher value denotes a more adverse outcome (O is binary in all of our outcome models).

For comparison with previous work, we first estimate linear models of average expenditure and outcome effects of the ownership status of each patient's hospital of admission. These models are of the form

$$\ln(R_{ikt}) = \delta_k + \sigma_t M_k + U_{ikt}\phi + (OWN_{jt} \,|Z_{jt})*\eta + OMC_{kt}\gamma + \xi_{ikt} \quad , \tag{1}$$

where $*_k$ is a zip-code fixed-effect; F_t is a time fixed-effect; M_k is a vector of six indicator variables denoting the size of individual i's MSA; OWN_{jt} is a vector of two indicator variables denoting whether hospital j is a public or a for-profit hospital (omitted group is non-profit); Z_{jt} is a vector of three indicator variables describing the size (>300 beds), teaching status, and system membership status of hospital j; OMC_{kt} is a vector of other market characteristics, including capacity utilization, the travel distance to the hospital nearest to zip code k, an indicator denoting whether the zip code was in the highest quartile of the distribution of HHIs, and indicators denoting whether the state has HMO enrollment above the 25th, 50th, and 75th percentile; and $>_{ikt}$

is a mean-zero independently-distributed error term with E($>_{ikt}$|. . .) = 0. Our dataset includes essentially all elderly patients hospitalized with the heart diseases of interest for the years of our study, so that our results describe the actual average changes in expenditures associated with changes in ownership. We report heteroscedasticity-consistent standard errors for inferences about average differences that might arise in potential populations (e.g., elderly patients with these health problems in other years).

In this model, 0 represents the impact on treatment intensity or health outcomes of admission to a hospital of a given ownership status. OLS estimates of 0 suffer from potential selection bias, because E($>_{ikt}$ | OWN_{jt}) ... 0. If hospital ownership (or any other hospital characteristic) does affect productivity, and sicker patients (who value productivity more highly) seek out more productive hospitals, then estimates of the impact of ownership status that do not completely control for patient heterogeneity will represent a combination of the true impact and unobserved differences between patient populations. Furthermore, if the true model of the impact of ownership status on medical productivity includes both a direct effect of the ownership status of a patients' hospital of admission and a strategic effect of the ownership status of other hospitals in a relevant market, even IV estimates of 0 from equation (1) would be inconsistent.

To address these issues, we estimate models of the area effects of the density of admission to hospitals of different ownership type, holding constant the area densities of admissions to hospitals with various other characteristics, and the competitiveness and other characteristics of hospital markets:

$$\ln(R_{ikt}) = \delta_k + \sigma_t M_k + U_{ikt}\phi + (OWN_{kt}\,|Z_{kt})*\eta + OMC_{kt}\gamma + \xi_{ikt}, \qquad (2)$$

where OWN_{kt} is a vector of two indicator variables denoting whether zip code k has above the median density of for-profit relative to non-profit hospitals, or public relative to non-profit hospitals, and Z_{kt} is a vector of three indicator variables denoting whether zip code k has above-median density of large, teaching, and system hospitals. We also estimate an alternative version of this model (equation (2a)) that includes for each characteristic in OWN_{kt} and Z_{kt} two indicator variables denoting whether zip code k has probabilistic-admission-weighted for-profit/non-profit (or other type of) relative density above the median, and relative density above the 75th percentile, to investigate the impact of increasing rates of for-profit and public ownership status at different levels of relative ownership.

IV. Data

We use data from four sources. First, we use comprehensive longitudinal Medicare claims data for the vast majority of elderly nonrural beneficiaries who were admitted to a hospital with a new primary diagnosis of acute myocardial infarction (AMI) from any year between 1985 and 1996. Data on patient demographic characteristics were obtained from the Health Care Financing Administration's HISKEW enrollment files. Patients with admissions for the same illness in the prior year were excluded to insure that we examine only new occurrences of illness. We calculate several different measures of the financial consequences of differences in hospital ownership. We calculate total one-year hospital expenditures by adding up all acute plus nonacute inpatient hospital reimbursements (including copayments and deductibles not paid by Medicare) from insurance claims for all treatments in the year following each patient's initial admission for AMI. This is a nontrivial exercise under the diagnosis-related group (DRG)

Medicare prospective payment system (PPS), since more intensive treatments, transfers, and readmissions lead to higher expenditures, and hospital ownership status may affect resource use through these channels. For example, an AMI patient receiving a surgical procedure would be classified into one of 18 different DRGs, which are generally (but not always) more highly compensated than nonsurgical DRGs (see Medicode 2000 for a list of DRGs; see McClellan 1997 for a detailed explanation of PPS reimbursement as a value-weighted sum of quantities of treatment).

We also examine the effects of ownership on the five main components of expenditures. Payment for most PPS admissions consists of a basic payment (primarily the base payment rate multiplied by the relative weight of the patient's DRG), adjusted by a labor cost index, plus an additional "outlier" payment for very costly cases.[4] We decompose total payments for each patient into the Medicare labor cost index of the patient's geographic area (approximately the patient's MSA), the patient's basic and outlier payments for all cardiac-related admissions (DRG 103- DRG 145) and the patient's basic and outlier payments for noncardiac admissions.

We examine three measures of health outcomes. We calculate mortality rates within one year of the index AMI admission with death dates based on death reports validated by the Social Security Administration. Measures of the occurrence of cardiac complications were obtained by abstracting data on the principal diagnosis for all subsequent admissions (not counting transfers and readmissions within 30 days of the index admission) in the year following the patient's initial admission. Cardiac complications included rehospitalizations within one year of the initial event

[4]See www.hcfa.gov/medicare/ippsover.htm for a more detailed discussion of the steps in determining a PPS payment.

with a primary diagnosis (principal cause of hospitalization) of either subsequent AMI or heart failure. Treatment of AMI patients is intended to prevent subsequent AMIs if possible, and the occurrence of heart failure requiring hospitalization is evidence that the damage to the patient's heart from ischemic disease has serious functional consequences.

Second, we use data on U.S. hospital characteristics collected by the American Hospital Association (AHA). The response rate of hospitals to the AHA survey is greater than 90 percent, with response rates above 95 percent for large hospitals (>300 beds). Because our analysis involves nonrural Medicare beneficiaries with AMI, we examine only nonrural, nonfederal hospitals that ever reported providing general medical or surgical services (for example, we exclude psychiatric and rehabilitation hospitals from analysis). To assess hospital size and bed capacity per patient, we use total general medical/surgical beds, including ICU/CCU and emergency beds. We classify hospitals as teaching hospitals if they report at least 20 full-time residents.

Third, we use a hospital system database constructed from multiple sources (see Madison 2001 for a detailed discussion). The AHA survey contains extensive year-by-year information on hospital system membership status. First, the AHA supplies a system identification code (SYSID) that groups hospitals into systems according to an internal AHA process. Second, the AHA asks hospitals to self-report any system affiliations that they might have. Our validity checking indicated that the universe of systems and system hospitals, and the timing of hospitals' system membership, as defined by AHA did not conform to discussion of hospital systems in the trade press such as *Modern Healthcare*. We therefore created our own system database based on the AHA SYSID, the AHA self-reported system affiliation, and our own research using other sources, including results from an annual survey of hospital systems published in *Modern Healthcare*. We also corrected the timing of hospitals' reported entry and exit from systems as defined by the AHA, based on independent sources and our own algorithms. For example, if a hospital reported membership in a system from 1985-1990, and from 1992-95, we imputed that hospital's system membership in 1991.

Fourth, we calculate annual HMO enrollment rates by state based on information from InterStudy Publications, a division of Decision Resources, Inc. Enrollment rates were calculated by dividing the number of enrollees (exclusive of Medicare supplemental enrollees) by the population. We excluded residents of the District of Columbia from all analyses because of concerns about the validity of measured HMO enrollment rates for DC.

Table I describes the population of elderly AMI patients and the characteristics of the hospital markets serving their residential zip codes. The first column describes our overall sample, the next three columns describe patient characteristics by ownership status of their hospital of initial admission, and the last three columns describe the relative differences in each of these characteristics for the different ownership types. The first row of the table shows that the inpatient treatment intensity of elderly AMI patients was similar across ownership types. In the year after AMI, acute plus nonacute inpatient hospital expenditures of patients admitted to for-profit hospitals were about 1 percent lower than those of patients admitted to public hospitals, and about 2 percent lower than those of patients admitted to non-profit hospitals. But there are clear differences in patients across ownership forms: public hospital patients were much more likely to be black than non-profit or for-profit patients. In addition, patients admitted to non-profit hospitals had substantially lower one-year mortality rates: approximately 2 percentage points lower than patients admitted to either a public or a for-profit hospital.

The last rows of Table I show how patients were divided into the geographic areas on which our principal analysis is based. Public hospital attendance is strongly concentrated in zip codes with above median density of public hospitals. Fully 96.8 percent of all public hospital admissions occurred in areas with above median density of public hospitals, as compared to 75 percent of all for-profit admissions occurring in areas with above median density of for-profit hospitals. The cutoffs in Table I show that the median area is very heavily non-profit -- the median area has approximately 77 times (1/.013) the density of probabilistic admissions to a non-profit as to a for-profit hospital, and approximately 35 times (1/.029) the density of probabilistic admissions to a non-profit as to a public hospital. Table I also reflects the dominance of the non-profit form in the hospital industry: approximately 81 percent of elderly AMI patients were initially admitted to a non-profit hospital, with the remaining 19 percent split almost equally between for-profit and public hospitals.

Finally, Table I shows that market and other hospital characteristics are correlated with hospital ownership status. For example, for-profit areas are substantially more competitive than non-profit areas (less likely to be very concentrated, i.e., in the top HHI quartile), have higher rates of bed capacity, and slightly lower rates of HMO enrollment. Along with the differences by ownership in patient characteristics, this suggests that differences in expenditures and health outcomes by ownership status may be due to other differences in the characteristics of individual hospitals (such as system membership or teaching status) that may be correlated with ownership status; differential selection of patients on the basis of their health status into different types of hospitals; and market effects, including both market competitiveness and spillover effects of ownership.

V. Results

Table II presents OLS estimates of the effect of ownership status of hospital of admission on individuals' Medicare expenditures and health outcomes, controlling for individual characteristics, other characteristics of hospital of admission, market characteristics, zip-code fixed effects, and time fixed effects. Table II suggests that patients admitted to either for-profit or public hospitals have both higher levels of expenditures and much worse health outcomes than do patients admitted to non-profit hospitals. The public/non-profit mortality gap is huge, at almost 3.2 percentage points. Teaching hospitals, according to this analysis, deliver much more costly care without offering corresponding health benefits. Indeed, patients initially admitted to a teaching hospital have marginally higher rates of cardiac complications. On their face, these results suggest that the non-profit form leads to higher levels of medical productivity. But the magnitude of the differences also suggests that the selection of patients on the basis of their unobserved health status into different types of hospitals may also be an important determinant of observed differences by ownership status in health care costs and outcomes.

Table III shows that such effects are important. The table presents estimates from equations (2) and (2a) of area effects of the density of different hospital ownership types, holding constant the density of other hospital characteristics, hospital market structure, and characteristics of patients and geographic areas. Estimates of the impact of ownership structure O from equations (2) and (2a) are a combination of the average direct effect of the ownership of the hospital of initial admission (incorporating subsequent transfers) and the strategic interaction effects of hospitals within a residential zip code.

The left panel of Table III presents estimates of equation (2), and shows that patients from areas with above-median density of for-profit/non-profit hospitals have statistically significantly lower levels of total expenditures as compared to patients from areas with below-median density, of approximately 2.4 percent. Patients from areas with above-median relative density of public/non-profit hospitals have slightly greater expenditures (approximately 1.2 percent).

Neither a presence of for-profit nor a presence of public hospitals in an area has a significant effect on patient health outcomes from AMI. Coupled with the estimated expenditure effects above, this implies that the additional treatment delivered in an area with essentially no admissions to for-profit hospitals has an expenditure/outcome effect ratio of over $1,000,000 per additional AMI survivor to one year in 1994 dollars; using the upper bound of the 95-percent confidence intervals for the mortality effects leads to an estimated expenditure/effect ratio of approximately $120,000 per additional AMI survivor (the difference arises out of the small size and the imprecision of the estimated mortality effects).[5]

Other hospital characteristics also affect health care expenditures and health outcomes. Patients from areas with a substantial presence of system hospitals have slight less costly care without experiencing any worse outcomes. In contrast to the OLS results, patients from areas with a substantial presence of teaching hospitals receive only slightly more costly care, but experience statistically significantly better health outcomes (at the 10 percent level). Using the point estimates of expenditure and mortality effects, the additional treatment for AMI delivered

[5]Given mean 1996 expenditures of $21,885 (1994 $), .024*$21,855/.00027 = $1,942,667; evaluated at the upper bound of the mortality confidence interval .024*$21,855/[.00027+(1.96*.00203)] = $123,451.

in areas with above-median density of probabilistic admissions to teaching hospitals had an expenditure/benefit ratio of approximately $59,000 per year of life saved[6] – with no significant increase in cardiac complications rates, indicating that the additional survivors were not in markedly worse health.

The right panel of Table III presents estimates from equation (2a) of the effect of being above the median and the 75th percentile of the probabilistic-admission weighted density of different hospital characteristics. The incremental effect of for-profit ownership on expenditures diminishes as an area moves from the median to the 75th percentile of the distribution of for-profit ownership. Especially given the very large difference between the relative share of patients with a probabilistic admission to a for-profit in the median area (.013) and the relative share of patients with probabilistic admission to a for-profit in the 75th percentile area (.188), this result suggests that for-profit hospital ownership has a strongly nonlinear or threshhold effect on hospital expenditures. However, patients from areas with above the 75th percentile level of for-profit density do have a statistically significantly greater rate of readmission for heart failure, although this effect is very small in magnitude (less than one-quarter of one percentage point). Density of public hospitals, in contrast, has an expenditure-increasing effect at the median, turning to an expenditure-decreasing effect at the 75th percentile.

Table IV presents estimates of the effect of area densities of hospital characteristics on each of the components of expenditures: the Medicare labor cost index, and the basic and outlier

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[6] .00741*$21,855/.00273 = $59,321.

payments for cardiac and noncardiac admissions.[7] The effect of for-profit hospitals on total expenditures from Table III comes through two channels: lower labor costs and lower basic payments for cardiac admissions. The effects of area density of for-profit hospitals on the other main components of expenditures are small in relative terms. For example, the (statistically significant) effect of for-profit density on the probability of cardiac outlier payments is only 3.5 percent as large as the total effect (.00167*$8,905/(.024*$17,309)). The labor cost index is affected most by the presence of for-profit hospitals, and secondarily by the density of system hospitals. Density of public, teaching, and large hospitals have insignificant effects on hospitals' labor costs.

Since our models are identified under the assumption that differential distances and changes in differential distances between patients and hospitals are exogenous, we investigated whether accounting for the possibility of endogenous changes in hospitals' ownership status affects our results. First, we estimated a variant of equation (2) that includes contemporaneous plus one and two periods leads and lags of area densities of all of the five hospital characteristics (because of the leads and lags, these models are estimated using data on AMI patients from 1987-1994). Table V presents only the estimated effects of contemporaneous, leading, and lagged ownership status characteristics from these models. The coefficient estimates in the first five rows of the table trace out the time path of the effect of density of for-profit hospitals in an area.

[7]The models underlying the results in this table are estimated at the patient level, except for the Medicare labor cost index model, in which one observation is one Medicare-labor-cost area (approximately equivalent to an MSA) for one year (N = 4,221). The Medicare labor cost index model includes as controls Medicare-area fixed effects, time fixed effects allowed to vary by size of MSA, and Medicare-area average values for market and patient characteristics. In addition, the Medicare labor-cost index model weights each observation by the number of AMI patients.

The leading effects of above-median density of for-profit hospitals on expenditures are both small in magnitude and neither of the effects nor their sum is statistically distinguishable from zero (heteroscedasticity-consistent standard error of the sum of the leading coefficients is .586). In contrast, the contemporaneous and lagged effects are large and statistically significant (standard error of the sum is .684). Density of public hospitals has a significant negative leading effect and positive (but insignifcant) lagged expenditure effects.

Second, following the finding in Cutler and Horwitz (2000) that financial considerations may affect hospitals' decision to change ownership status, and because financial considerations may lead to hospital closures, we reestimated the models underlying Table IV with controls for area hospitals' financial condition. Using Medicare cost reports, we constructed four measures of financial distress: whether each hospital's ratios of assets/liabilities and patient revenues/operating expenses were in the lowest decile of all hospitals in our sample, and in the lowest decile of all hospitals of similar ownership status (see Arnould, Bertrand, and Hallock 2000 for discussion of measurement of non-profit hospital financial performance). Then, treating this like any other hospital characteristic, we calculated for each residential zip-code the probabilistic-patient-flow weighted density of hospital financial distress. Including these four area-level controls individually or in various combinations did not affect substantially the estimated expenditure effects of for-profit ownership, system membership, or teaching status, or the estimated mortality benefits of teaching hospitals, but did lead the estimated expenditure effect of public ownership to become small, negative, and significant.

Third, following the finding in Hassett and Hubbard (2000) that area income and educational attainment levels may affect for-profit hospitals' propensity to acquire area non-profits, we reestimated the models underlying Table IV with controls for area mean household income and the proportions of the population aged 25 or more who were graduates of high school and of college, calculated from the March Current Population Surveys (CPS). For those patients from the approximately 240 MSAs with population greater than 100,000 for which the CPS provides MSA identifiers (covering approximately 75 percent of nonrural AMI patients), we calculated MSA-average population characteristics. For the remaining 120 MSAs (approximately 25 percent of patients), we calculated state-average population characteristics based on individuals in small MSAs and rural areas. Including these area-level controls had no substantial impact on any of our estimated effects.

VI. Conclusion

What is the impact of hospital ownership status on medical productivity and social welfare? The theoretical literature on this question has generally focused on differences in behavior between not-for-profit and for-profit organizations: non-profits might address contract failures in the presence of informational asymmetries between consumers and producers. Non-profit hospitals may offer consumers the advantage that physicians and hospital managers either do not or can not pursue pure profit maximization, and so have less of an incentive and/or ability to engage in opportunistic, socially inefficient behavior. On the other hand, because non-profit hospitals do not have a well-defined residual claimant with legally enforceable property rights, they may be less responsive to consumers than for-profits, or more prone to inefficient and/or opportunistic behavior by managers and physicians.

In the hospital industry, the economic importance of the direct effects of differences in behavior between for-profits and non-profits is limited by the quite small share of the for-profit market. Even if for-profit hospitals were much more efficient, barring major changes in patient flows, they could hardly have much of a direct overall impact on the efficiency of the hospital industry. Few studies have addressed a potentially much more important effect of for-profit ownership: the effects of an increasing presence of for-profit ownership on the behavior of other hospitals. For-profit hospitals may still have a significant overall effect on welfare, if their presence leads to welfare-improving changes in the behavior of not-for-profit hospitals in the market.

Estimating the magnitude of the direct and spillover effects of hospital ownership on productivity and welfare is complicated by many features of markets for health care. First, reaching conclusions about welfare effects requires measures of both resource use and patient health outcomes, which are generally difficult to obtain. Second, methods that seek to estimate the impact of ownership by direct comparisons of patients treated at different types of hospitals are likely to suffer from biases due to both patient selection, and to changes in market competitiveness and other market characteristics that may be correlated with ownership changes and that also affect hospital behavior. Third, even if the studies overcome these problems, they will not have estimated the spillover effects of hospital ownership; and without considering such market-level implications, any welfare analysis of hospital ownership is incomplete.

Finally, other characteristics of hospitals may have market effects. For example, a greater presence of teaching hospitals may lead to more intensive styles of practice in an area, both as a result of direct effects or (because the share of teaching hospital beds in most areas is also relatively small) spillovers of practice styles among the physicians practicing in area hospitals.

Hospital system membership may also have both direct and spillover effects, if systems result in more efficient management practices and more opportunities for collusion. All of these other hospital market characteristics may be associated with differences in ownership, complicating the estimation of ownership effects. For all of these reasons, the effect of hospital ownership on social welfare is an incompletely resolved empirical question.

To address this question, we use longitudinal data on nonrural elderly Medicare recipients hospitalized for a treatment of a new heart attack between 1985 and 1996, matched with comprehensive data on all nonrural U.S. hospitals over the same period. This enables us to examine both the financial costs and the health benefits of hospital treatment, in order to evaluate welfare effects more completely. We use zip-code fixed effects to control for all time-invariant heterogeneity across small geographic areas, hospitals, and patient populations. We model individual patients' hospital choice decisions as a function of exogenous patient, area, and hospital characteristics, particularly the relative travel distances between patients' residences and hospitals of different types. Estimates from these models provide for each patient the probability of admission to every nearby hospital, based only on arguably exogenous factors, and therefore the relative probability of admission to hospitals of different ownership types. With these estimates, we construct area-based measures of the "density" of hospitals of different ownership types -- that is, the probability that a patient residing in an area will be admitted to a hospital of a given ownership type, based only on exogenous determinants of hospital demand. This allows us to avoid the problem of patient selection into different types of hospitals on the basis of unobservable characteristics.

Focusing on area-level effects of ownership and other market characteristics also allows us to capture potentially important spillover effects. Because we measure the market-level consequences of changes in market composition, our methods do not allow us to identify separately the contribution of direct and spillover effects. However, the total impact of a change in ownership composition will generally be the more relevant empirical estimate for evaluating policy proposals that may influence the ownership composition of hospital markets. In addition, we develop indirect evidence on the relative importance of direct and spillover effects. All else equal, if direct effects are relatively important, for-profit ownership should have minimal consequences at low levels of for-profit market penetration, and should become more important in proportion to market penetration. In contrast, spillover effects may be relatively large when for-profit ownership penetration is small, if the presence of for-profit hospitals induces significant changes in non-profit behavior. Moreover, the area-level effect may not increase as rapidly as for-profit penetration rises.

Thus, it is not surprising that our analysis yields substantially different conclusions about the effects of ownership composition on market performance than least-squares estimates of the direct effects of ownership would imply. Higher market density of for-profit hospitals results in significantly lower hospital expenditures for AMI patients, with no consequential effects on their mortality or cardiac health. This effect appears to be predominantly due to spillovers. Significant expenditure savings are achieved when the for-profit presence increases from near zero to only a small fraction of admissions in the area; a share of admissions of less than 10 percent is simply not substantial enough for any reasonably-sized direct effect to lead to the large effects on area expenditures that we observe. Additional penetration of for-profits to higher market shares leads to sharply declining additional savings. We document that approximately half of the expenditure savings achieved by penetration of for-profit hospitals comes about through reductions in Medicare's area hospital labor cost index, which is an intuitively plausible mechanism through which spillovers would occur.

We also provide evidence that the for-profit effect we estimate is not likely to be due to endogenous changes in area ownership structure. There is no evidence that changes in productivity in an area lead changes in the density of for-profits. Controlling for area income, education, and hospital financial conditions also do not affect the estimated effect of for-profit hospitals.

Our analysis has certainly not resolved all of the critical empirical questions in evaluating hospital ownership effects. We have focused on only one condition; effects may be different for other types of health problems. We have evaluated only net expenditure effects. Consistent with the theoretical prediction that for-profits are more responsive to economic incentives, other work has suggested that for-profits may have been more aggressive in exploiting Medicare's complex regulated price system, by moving care from the inpatient setting to alternative settings – including rehabilitation hospitals, outpatient departments, and home care – all of which qualify for additional reimbursement. In this regard, it is interesting that the association we observed in our previous work between market bed capacity and higher hospital expenditures is in part an ownership phenomenon. In results not presented in the tables, we find that higher bed capacity does not affect hospital expenditures to as great an extent once we account for its correlation with ownership. This may be a confirmation of theoretical predictions (Newhouse 1970; Pauly and Redisch 1973): not-for-profits prefer larger size, and so will tend to invest in excess bed capacity especially when competition from for-profits is weak. However, it might also reflect the fact that for-profits are simply more apt to convert bed capital to more profitable (i.e., reimbursable) uses, such as rehabilitation services. More complete identification of the mechanism through which for-profit spillover effects occur is an important question for further work. Evaluation of market competition and composition effects for stroke, which involves much more post-acute care than heart attacks, might be a good condition for such an analysis. That analysis could use methods similar to those developed and applied here.

Finally, while we have focused on market-wide effects, we have done so only for Medicare beneficiaries. It is possible that the apparently favorable productivity spillovers of for-profits for Medicare beneficiaries may be offset by less provision of public goods in the form of undercompensated care for uninsured or poorly-insured patients. With suitable data, our techniques could also be extended to examine effects on these other market segments.

Table I: Descriptive Statistics for Elderly AMI Patients, by Ownership Status of Hospital of Admission, 1985-1996

	Full Sample	Public	Non-Profit	For-Profit	% diffs between ownership status FP-NP/NP	FP-P/P	NP-P/P
Inpatient Expenditures, year after AMI (94$)	17,309	17,183	17,356	17,002	-2.0%	-1.1%	1.0%
365 Day Mortality Rate	36.5%	38.3%	36.1%	38%	5.3%	-0.8%	-5.7%
365 Day AMI Rate	5.5%	5.5%	5.5%	5.1%	-7.3%	-7.3%	0.0%
365 Day CHF Rate	6.9%	6.9%	6.9%	6.5%	-5.8%	-5.8%	0.0%
Age	76.3	75.9	76.3	76.5	0.3%	0.8%	0.5%
Black	6.3%	10.2%	6.0%	5.3%	-11.7%	-48.0%	-41.2%
Female	50.4%	49.8%	50.6%	49.8%	-1.6%	0.0%	1.6%
MSA Size <100,000	1.9%	3.2%	1.8%	1.2%	-33.3%	-62.5%	-43.8%
MSA Size 100,000 - 250,000	14.7%	20.5%	14.1%	14.3%	1.4%	-30.2%	-31.2%
MSA Size 250,000 - 500,000	14.2%	15.1%	14.0%	15.3%	9.3%	1.3%	-7.3%
MSA Size 500,000 - 1,000,000	21.9%	19.2%	22.7%	18.1%	-20.3%	-5.7%	18.2%
MSA Size 1,000,000 - 2,500,000	25.5%	29.1%	24.1%	32.9%	36.5%	13.1%	-17.2%
MSA Size >2,500,000	21.7%	12.6%	23.1%	18.0%	-22.1%	42.9%	83.3%
Above median FP/NP [median = .013]	50%	75.0%	41.2%	99.2%	141.0%	32.3%	-45.1%
Above median Pub/NP [median = .029]	50%	96.8%	41.9%	74.4%	77.6%	-23.1%	-56.7%
Above median System [median = .513]	50%	44.4%	47.2%	77%	63.1%	73.4%	6.3%
Above median Teaching [median = .206]	50%	34.6%	54.9%	24.4%	-55.6%	-29.5%	58.7%
Above median Large [median = .299]	50%	41.9%	50.9%	49.5%	-2.8%	18.1%	21.5%
Above 75th Percentile FP/NP [75th pct = .188]	25%	46.8%	14.8%	87.7%	492.6%	87.4%	-68.4%
Above 75th Percentile Pub/NP [75th pct = .133]	25%	86%	15.2%	50.5%	232.2%	-41.3%	-82.3%
Above 75th Percentile System [75th pct = .728]	25%	21.1%	23%	44.1%	91.7%	109.0%	9.0%
Above 75th Percentile Teaching [75th pct=.463]	25%	14.9%	28.3%	7.3%	-74.2%	-51.0%	89.9%
Above 75th Percentile Large [75th pct = .491]	25%	24.8%	25.3%	23.2%	-8.3%	-6.5%	2.0%
Very Concentrated Market	25%	33.7%	24.7%	20.2%	-18.2%	-40.1%	-26.7%
State HMO enrollment rate	14%	12.1%	14.4%	12.9%	-10.4%	6.6%	19.0%
Bed capacity per AMI patient	3.32	3.65	3.21	3.89	21.2%	6.6%	-12.1%
N	1,661,674	146,193	1,345,217	167,616			

Table II: OLS Estimates of the Effect of Hospital Ownership Status and Other Characteristics of Hospital of Admission on Expenditures, Costs, and Outcomes for Elderly Acute Myocardial Infarction Patients, 1985-96

	Dependent Variable			
	ln(Inpatient Expenditures)	1-Year Mortality	1-Year AMI Readmit	1-Year HF Readmit
For-profit	2.177 (0.271)	1.641 (0.173)	0.063 (0.081)	0.088 (0.090)
Public	4.338 (0.290)	3.195 (0.185)	0.324 (0.090)	0.382 (0.099)
System member	-0.534 (0.156)	-0.030 (0.099)	-0.034 (0.048)	-0.047 (0.053)
Large size	3.921 (0.179)	-1.638 (0.113)	-0.044 (0.055)	-0.061 (0.062)
Teaching status	10.822 (0.198)	-0.127 (0.124)	0.209 (0.060)	0.295 (0.068)

Notes: Heteroscedasticity-consistent standard errors in parentheses. Hospital Expenditures in 1994 dollars. Coefficients from expenditures models *100 from regressions in logarithms; coefficients from outcome models in percentage points.

Table III: Effects of Area Density of Hospital Ownership on Expenditures and Outcomes for Elderly AMI Patients, 1985-1996

	Dependent Variable							
	Model (2): controls for above median only				Model (2a): controls for above median and above 75th percentile			
	ln(Inpatient Hospital Expenditures)	1-Year Mortality	1-Year AMI Readmit	1-Year HF Readmit	ln(Inpatient Hospital Expenditures)	1-Year Mortality	1-Year AMI Readmit	1-Year HF Readmit
Above median density of	-2.425	0.027	-0.018	0.109	-2.146	-0.025	-0.012	0.093
for-profit/non-profit [median = .013]	(0.315)	(0.203)	(0.098)	(0.109)	(0.319)	(0.205)	(0.099)	(0.110)
Above median density of	1.169	0.169	-0.039	-0.016	1.567	0.077	-0.041	-0.013
public/non-profit [median = .029]	(0.293)	(0.187)	(0.090)	(0.101)	(0.299)	(0.191)	(0.092)	(0.103)
Above median density of	-2.090	0.021	-0.013	-0.004	-1.685	0.003	0.001	0.022
system hospitals [median = .513]	(0.216)	(0.137)	(0.066)	(0.074)	(0.225)	(0.142)	(0.068)	(0.077)
Above median density of	0.741	-0.273	0.091	0.064	0.998	-0.290	0.113	0.084
teaching hospitals [median =.206]	(0.257)	(0.163)	(0.079)	(0.088)	(0.260)	(0.165)	(0.080)	(0.089)
Above median density of	1.019	-0.014	-0.063	-0.112	0.662	-0.193	-0.058	-0.101
large hospitals [median = .299]	(0.229)	(0.143)	(0.070)	(0.078)	(0.236)	(0.148)	(0.073)	(0.081)
Above 75th percentile density of					-1.087	0.167	-0.049	0.135
for-profit/non-profit [75th pct = .188]					(0.351)	(0.226)	(0.107)	(0.117)
Above 75th percentile density of					-2.352	0.465	-0.013	-0.071
public/non-profit [75th pct = .133]					(0.302)	(0.191)	(0.092)	(0.102)
Above 75th percentile density of					-1.505	0.049	-0.057	-0.114
system hospitals [75th pct = .728]					(0.242)	(0.155)	(0.074)	(0.082)
Above 75th percentile density of					-1.439	0.003	-0.160	-0.160
teaching hospitals [75th pct = .463]					(0.280)	(0.177)	(0.087)	(0.096)
Above 75th percentile density of					1.394	0.077	-0.010	-0.024
large hospitals [75th pct = .491]					(0.242)	(0.154)	(0.075)	(0.083)

Notes: See notes to table II.

Table IV: Effects of Area Density of Hospital Ownership on Components of Expenditures for Elderly AMI Patients, 1985-1996

	Dependent Variable							
		Cardiac-related Admissions Only (DRG 103- DRG 145)			Non-cardiac-related Admissions Only			
	ln(Medicare labor cost index)	ln(Basic payment)	Outlier payment (1=yes)	ln(Outlier payment)	Basic payment (1=yes)	ln(Basic payment)	Outlier payment (1=yes)	ln(Outlier payment)
Above median density of	-1.452	-1.965	-0.167	4.717	0.381	0.216	-0.047	-7.046
for-profit/non-profit [median = .013]	(0.605)	(0.283)	(0.088)	(3.129)	(0.187)	(0.761)	(0.047)	(7.151)
Above median density of	0.359	1.253	-0.234	-3.879	-0.097	0.383	-0.034	-1.801
public/non-profit [median = .029]	(0.570)	(0.261)	(0.083)	(2.903)	(0.173)	(0.707)	(0.045)	(6.223)
Above median density of	-1.256	-1.422	-0.219	5.983	-0.127	-0.799	-0.034	7.776
system hospitals [median = .513]	(0.501)	(0.194)	(0.062)	(2.071)	(0.127)	(0.519)	(0.034)	(4.680)
Above median density of	0.041	0.557	0.051	4.916	0.083	0.516	-0.057	5.740
teaching hospitals [median = .206]	(0.572)	(0.228)	(0.075)	(2.385)	(0.152)	(0.618)	(0.041)	(5.647)
Above median density of	0.477	1.200	0.165	-6.142	-0.159	1.772	0.006	1.909
large hospitals [median = .299]	(0.511)	(0.206)	(0.066)	(2.107)	(0.134)	(0.547)	(0.036)	(4.650)
mean value of dependent variable	1.0277	13,327	0.0468	8,932	0.2508	12,341	0.0134	10,896

Notes: See notes to Table II. All models are patient-level except Medicare labor cost index model, in which one observation is one Medicare-labor-cost-area (approximately equivalent to an MSA) for one year (N = 4,221). Medicare labor cost index model includes as controls Medicare-area fixed effects, time fixed effects allowed to vary by size of MSA, and Medicare-area average values for market and patient characteristics. Medicare labor-cost index model weights each observation by the number of AMI patients. For payments variables, mean values are based on levels not logs of nonzero observations.

Table V: Effects of Area Density of Hospital Ownership on Expenditures and Outcomes for Elderly AMI Patients, Dynamic model, 1985-1996

	Dependent Variable			
	ln(Inpatient Expenditures)	1-Year Mortality	1-Year AMI Readmit	1-Year HF Readmit
Above median density of for-profit/non-profit				
Two period lead	-0.227 (0.531)	0.063 (0.345)	0.174 (0.165)	0.072 (0.185)
One period lead	-0.695 (0.470)	-0.043 (0.307)	0.189 (0.145)	-0.148 (0.162)
Contemporaneous	-1.240 (0.544)	-0.597 (0.356)	-0.333 (0.169)	-0.053 (0.190)
One period lag	-1.168 (0.535)	0.913 (0.349)	-0.068 (0.166)	-0.220 (0.185)
Two period lag	-1.766 (0.491)	0.420 (0.320)	0.079 (0.153)	0.106 (0.172)
Above median density of public/non-profit				
Two period lead	-0.236 (0.425)	0.105 (0.276)	0.198 (0.130)	0.076 (0.148)
One period lead	-1.278 (0.410)	-0.038 (0.266)	-0.063 (0.125)	-0.008 (0.141)
Contemporaneous	0.363 (0.429)	0.297 (0.280)	-0.137 (0.132)	-0.213 (0.151)
One period lag	-0.071 (0.426)	0.068 (0.277)	-0.156 (0.131)	-0.371 (0.150)
Two period lag	0.207 (0.412)	-0.309 (0.267)	-0.004 (0.127)	0.045 (0.142)

Notes: See notes to Table II.

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