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THE EFFECTS OF COMPETITION ON VARIATION IN THE QUALITY AND COST OF MEDICAL CARE

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ABSTRACT

We estimate the effects of hospital competition on the level of and the variation in quality of care and hospital expenditures for elderly Medicare beneficiaries with heart attack. We compare competition's effects on more-severely ill patients, whom we assume value quality more highly, to the effects on less-severely ill, low-valuation patients. We find that low-valuation patients in less-competitive markets receive more intensive treatment than in more-competitive markets, but have statistically similar health outcomes. In contrast, high-valuation patients in less-competitive markets receive less intensive treatment than in more-competitive markets, and have significantly worse health outcomes. Since this competition-induced increase in variation in expenditures is, on net, expenditure-decreasing and outcome-beneficial, we conclude that it is welfare-enhancing. These findings are inconsistent with conventional models of vertical differentiation, although they can be accommodated by more recent models.

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Introduction

Recent studies have emphasized the importance of vertical differentiation in markets for hospital services. Yet, most analyses of how hospitals compete do not investigate competition's effects on hospitals' strategic choice of quality of care. In this paper, we estimate empirically how conventional measures of hospital market competitiveness affect the distribution across patients of health outcomes and medical expenditures. This contributes to the existing literature in at least three ways.

First, different theoretical models offer opposing predictions of how competition affects vertical differentiation. Thus, empirical evidence can be used to test such models against one another. Second, estimates of the effect of competition on vertical differentiation are important for policy making. For example, understanding whether competition benefits all patients equally, or benefits some patients at the expense of others, improves the targeting and coordination of antitrust and other health care quality regulatory policies. Third, many researchers have argued that the substantial variation in the cost of medical care across geographic areas is socially wasteful (see Fisher et al. 2003 for a comprehensive cataloguing of this work). Estimates of the effect of competition on area variation in quality and cost can therefore indicate whether at least a portion of this variation is socially constructive or harmful.

In particular, we investigate how competition in hospital markets, as measured by a Hirschman-Herfindahl index (HHI), affects the health care utilization and outcomes of essentially all nonrural elderly individuals enrolled in traditional fee-for-service Medicare who suffered a new heart attack (AMI) between 1985 and 1996. We estimate the extent to which the HHI has different effects on patients with prior year hospital utilization and those without it, holding constant 5-digit-zip-code fixed effects and other characteristics of individuals and hospital markets. Because the health outcomes of prior-year-hospitalized AMI patients are substantially worse (and their utilization substantially higher), we describe them as "high-risk" and their prior-year-non-hospitalized counterparts as "low-risk." Consistent with previous research (e.g., Capps, Dranove, and Satterthwaite (2003)), we assume that high-risk patients have a higher willingness-to-pay for quality than low-risk patients. By examining how the HHI affects each of these two group's subsequent outcomes and expenditures, we explore both how competition affects variability in quality and how this competition-induced change in vertical differentiation affects social welfare.

The paper proceeds as follows. Section I briefly summarizes the previous research on this subject. Section II outlines our data and models. Section III presents our results. Section IV concludes.

I. Previous Research

Eliminating an independent competing hospital from a market changes neighboring hospitals' strategic incentives, thereby changing the types of treatment, prices, and qualities that they offer. According to this reasoning, the welfare effect of a change in competitiveness, such as a proposed merger, is determined by comparing the quality of and expenditures on treatment in competitive and uncompetitive markets, holding all other observed factors constant (e.g., Kessler and McClellan 2000).

Yet, as Tay (2003) shows, such an analysis is not a complete description of how hospitals compete. Quality may not be wholly endogenous. For example, if some hospitals are permanently high-quality and others permanent low-quality, then the effects of mergers may not be accurately predicted by a model that fails to account for vertical differentiation. In addition, even if quality is endogenous, simply knowing the average or total effect of a change in competition leaves many important issues unresolved. Changes in competition may benefit patients in aggregate but still harm some subgroups.

Theoretical models of vertical differentiation illustrate how this can happen. Conventional models (e.g., Gabszewicz and Thiesse 1980 and Shaked and Sutton 1982) emphasize how oligopoly increases quality variation at the expense of social welfare: firms try to relax price competition though differentiation (see Tirole 1989 section 7.5.1. for an excellent exposition of these models). In markets for hospital services, these models imply that oligopoly hospitals lower the quality of care for low-risk (i.e., low-valuation) patients in order to be able to charge their high-risk (i.e., high-valuation) counterparts more. In the terms of our empirical models, less-competitive markets should have greater variation in quality and expenditures, higher rates of mortality and cardiac complications for low-risk patients, and higher expenditures for high-risk patients.

In more recent work, however, Acharyya (1998) shows that without restrictions on cost functions, uncompetitive markets may or may not have more quality variation. Indeed, in an oligopoly model incorporating both horizontal and vertical differentiation, Anderson and De Palma (2001) show that under certain assumptions the unique equilibrium has all firms choosing a single (suboptimal) quality. In the terms of our empirical models, more recent work allows less-competitive markets to have higher rates of adverse outcomes and lower expenditures for high-risk patients, or low-risk patients, or both.

In this paper, we empirically test the hypotheses of these models. We separate patients into two groups: those with a low- versus a high valuation of quality based on a measure of their health status at the time of onset of illness. By estimating the effect of concentration on the mortality, cardiac complications, and medical expenditures of low- and high-valuation patients, and for patients overall, we investigate the extent to which conventional models of vertical differentiation explain behavior in hospital markets. In addition, these estimates allow us to identify the welfare consequences of competition-induced variation in quality. If an increase in variation leads to lower expenditures and better outcomes, then we conclude that it would increase welfare. If it leads to higher expenditures and worse outcomes, then we conclude that it would decrease welfare. If it leads to lower expenditures and worse outcomes (or higher expenditures and better outcomes), then we calculate the implied cost per life saved to determine its welfare effects.

II. Data and Models

Data

We use data from three sources. First, we use comprehensive individual-level longitudinal Medicare claims data from the Centers for Medicare and Medicaid Services (CMS) on the medical utilization of virtually all non-rural elderly fee-for-service Medicare beneficiaries with a new occurrence of a heart attack (AMI) in 1985-1996. We determine whether the individual had acute care hospital utilization in the year prior to his or her AMI as a measure of the severity of his/her illness. We calculate several measures of utilization in the year after the individual's AMI, including the following: total acute and non-acute (mostly skilled nursing)

Medicare expenditures (including deductibles and copayments) and total acute and nonacute days in the hospital in the year following their admission for the study illness. Measures of utilization include all inpatient reimbursements (including copayments and deductibles not paid by Medicare) from claims for all hospitalizations in the year following each patient's initial admission. 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 with a primary diagnosis (principal cause of hospitalization) of either subsequent AMI or heart failure (HF). Treatment of AMI patients is intended to prevent subsequent AMIs if possible, and the occurrence of HF requiring hospitalization is evidence that the damage to the patient's heart from ischemic disease has serious functional consequences. Data on patient demographic characteristics were obtained from CMS's HISKEW enrollment files, with death dates based on death reports validated by the Social Security Administration. The CMS HISKEW enrollment files include demographic information on virtually all elderly Americans (including those enrolled in Medicare HMOs) because of the extremely high rate of take-up in the Medicare program.

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). Third, we use a hospital system[1] 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. 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 a combination of the AHA and other sources.

Models

We model the effect of competition on the level and the dispersion between high-risk and low-risk patients of quality and medical expenditures. We identify the effect of competition with an HHI that is a function of distances from each patient to his hospital choices and other exogenous characteristics of patients and hospitals. To do this, we use a three-stage method.[2]

First, we specify and estimate patient-level hospital choice models as a function of exogenous determinants of the hospital admission decision. We do not constrain hospital geographic markets based on a priori assumptions. We allow each individual's potentially-relevant hospital market for cardiac-care services to include all nonfederal, general medical /surgical hospitals within 35 miles of the patient's residence with at least five admissions for AMI, and any large, nonfederal, general medical/surgical teaching hospital within 100 miles of the patient's residence with at least five AMI admissions. We model the extent to which

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[1]We define hospitals as members of a system if they are owned or controlled, in whole or in part, by a common entity.

[2]The following explanation follows the explanation in Kessler and McClellan (2000); that paper also contains a formal derivation of these methods.

hospitals of various types at various distances from each patient's residence affect each patient's hospital choice, and we also allow each patient's demographic characteristics to affect her likelihood of choosing hospitals of one type over another. The results of these models of hospital demand provide predicted probabilities of admission for every patient to every hospital in his or her potentially-relevant geographic market. We then estimate the predicted number of patients admitted to each hospital in the U.S., *based only on the geographic distribution and other observable, exogenous characteristics of patients and hospitals.*

Second, we calculate measures of competitiveness that are a function of these predicted patient flows (rather than actual patient flows or capacity), and assign them to patients based on their probabalistic hospital of admission (rather than their actual hospital of admission). Thus, the measure of competitiveness that we assign to each patient is uncorrelated with unobserved heterogeneity across individual patients, individual hospitals, and geographic hospital markets. We also calculate measures of the geographic density of the size distribution, teaching status, system-membership status, ownership status, and bed capacity per patient using predicted patient flows matched to each patient's area hospital characteristics.

Third, we use these unbiased indices of competitiveness, and interactions between these indices and a measure of patients' health at the time of onset of illness, to estimate the impact of competition on the level and dispersion of adverse health outcomes and utilization, holding other patient and area characteristics constant. In these models, observational units in our analysis consist of individuals $i=1,\ldots, N_{zt}$ (in zip code z and state s during year $t = 1,\ldots, T$) who are initially admitted to the hospital with a new occurrence of heart attack. Each patient has observable demographic characteristics X_{izt}: four age 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. Each patient has health status A_{izt}, where $A_{izt} = 1$ if the patient was high-risk (i.e., had an acute care hospital utilization in the year prior to his/her AMI). The patient then receives treatment of aggregate intensity R_{izt}, where R is one of five measures. The patient has a health outcome O_{izt}, 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).

We match to each patient by zip code and year several measures of the hospital market environment that have been shown to affect treatment and quality of care: the competitiveness of zip code z's hospital market at time t (HHI_{zt} = whether z was in the top or middle quartiles of the distribution of HHIs of predicted patient flows), and whether z had above the median density of patients admitted to large hospitals, teaching hospitals, hospitals that were members of multi-hospital systems, for profit versus nonprofit hospitals, and public versus nonprofit hospitals at time t (J_{zt}). To measure market size and isolate the effects of competition-induced dispersion from the effects of market-size-induced dispersion, we calculate each zip code's bed capacity and population at time t (K_{zt} and P_{zt}). In the presence of fixed costs, larger markets support a greater number of firms, which can lead to an observed positive correlation between variety and competitiveness even in the absence of any causal effect (see Berry and Waldfogel 1999 for discussion of these models).

We estimate linear models of outcome and utilization effects as a function of 5-digit zip-code and year-fixed-effects (α_z and θ_t); demographic characteristics (X_{izt}); health status (A_{izt});

competitiveness (HHI_{zt}); size, teaching, system, and ownership status distribution of area hospitals (J_{zt}); and bed capacity and population at time t (K_{zt} and P_{zt}). We allow the effect of market environment to vary depending on the individual's health status A_{izt}:

$$\begin{aligned} &\ln(R_{izt}) \\ &O_{izt} = \alpha_z + \theta_t + X_{izt}\phi + A_{izt}\Phi + I(A_{izt} = 0)*(HHI_{zt}\beta + J_{zt}\gamma + K_{zt}\delta + P_{zt}\eta) \\ &\qquad I(A_{izt} = 1)*(HHI_{zt}\beta^A + J_{zt}\gamma^A + K_{zt}\delta^A + P_{zt}\eta^A) + \epsilon_{izt}, \end{aligned} \tag{1}$$

where R_{izt} is total hospital expenditures, acute care hospital expenditures, nonacute care hospital expenditures, acute care hospital days, or nonacute care hospital days; O_{izt} is readmission for AMI within 1 year, readmission for heart failure within 1 year, or mortality within 1 year; I(.) is the indicator function; and ϵ_{izt} is an independently-distributed error term, with $E(\epsilon_{izt} | ...) = 0$.

III. Results

Table 1 presents trends in the distribution of Medicare expenditures and health outcomes for high-risk and low-risk patients. The fraction of patients whom we classify as high-risk ranges from 31.3 percent in 1985 (= 49441 / (108626 + 49441)) to 28.5 percent in 1996 (=44337 / (111370 + 44337)). Our proxy for health is strongly positively correlated with age and subsequent rates of adverse outcomes. High-risk patients are older, almost twice as likely to be readmitted with heart failure in the year after their AMI, and fully 14.7 percentage points more likely to die in the year after AMI (on a sample average mortality of 36.6 percent).

Although variation in utilization between high-risk and low-risk patients has risen over time in some dimensions, it has fallen in others. In particular, although the gap between the number of days spent in an acute care hospital in the year after AMI by high-risk versus low-risk patients rose from 21.3 to 27.1 percent, the gap between the total expenditures for a high-risk versus a low-risk patient fell from 12.5 to 8.3 percent. This shrinking of the high-risk versus low-risk expenditure gap is composed of a shrinking of the gap between the acute care expenditures of high-risk versus low-risk patients (in dollar terms, from $1,615 (=$15,270 - $13,655) to $908 (=$20,375 - $19,467)) and an expansion of the gap between the nonacute care expenditures (in dollar terms, from $80 (=$179 - $119) to $848 (=$2,452 - $1,604)) of the high-risk versus the low-risk.

Table 2 presents estimates of equation (1), the effects of competitiveness and other market characteristics on treatment intensity and health outcomes, allowing the effect of market environment to vary depending on the individual's health A_{izt}. The first row of Table 2 confirms that prior-year acute care hospital utilization is strongly positively correlated with subsequent intensity of treatment and rates of adverse outcomes. Holding constant their demographic characteristics, area fixed-effects, and other market characteristics, high-risk AMI patients have approximately 8.3 percent higher inpatient expenditures, 9.8 percent more inpatient days, 1.4 percentage points higher rates of readmission for AMI, 4.8 percentage points higher rates of readmission for heart failure, and almost 11 percentage points higher one-year mortality in the year after their AMI than their low-risk counterparts.

The top panel of Table 2 shows that less-competitive markets have higher expenditures for low-risk patients but not significantly better quality of care. Among the approximately 70 percent of patients who are low-risk, total hospital expenditures in the year after AMI were approximately 1.3 percent higher in the least-competitive as compared to the most-competitive hospital markets; living in a moderately-competitive market (the middle two quartiles of HHIs) leads to almost as large of an effect on expenditures. The effect is present in both acute and nonacute care settings, although substantially larger in percentage terms in nonacute care. Effects of competition on outcomes are extremely small and statistically insignificant.

The bottom panel of Table 2 shows that less-competitive markets have lower expenditures on and lower quality of care for high-valuation patients. Total hospital expenditures in the year after AMI were approximately 1.2 percent lower in the least-competitive quartile of hospital markets, as compared to all other markets. This effect is exclusively due to an decrease in acute care; providers in the least-competitive markets actually supply slightly more nonacute care. In addition, competition has large and statistically significant outcome consequences. Patients in the least-competitive hospital markets experience .82 percentage points higher one-year mortality than do patients in the most-competitive markets; this effect is smaller but still significant for patients in moderately-competitive markets.

These effects are substantial. In competitive markets, the difference in expenditures between high-risk and low-risk patients is approximately 2.5 percent higher (=1.235 - (-1.274)) than in uncompetitive markets; competition, then, expands the high-risk versus low-risk difference in expenditures by almost one-third (on a base of 8.3 percent in 1996, table 1B). In competitive markets, the difference in mortality between high-risk and low-risk patients is .60 percentage points lower (= -.822 - (-.221)) than in concentrated markets. In this context, competition shrinks the high-risk versus low-risk difference in mortality by approximately 4 percnet (on a base of 14.7 percentage points in 1996, table 1B). However, these extra survivors may be in marginal health: rates of readmission with cardiac complications are significantly higher in more-competitive hospital markets. This qualification should be interpreted with some caution, since readmission rates measure health outcomes only imperfectly: they represent a combination of the effect of competition on health and the effect of competition on hospital utilization conditional on health.

Other market characteristics affect both quality and expenditures. Most importantly, patients from areas with a high density of teaching hospitals have better health outcomes, regardless of their health status on admission. Low-risk patients from high-teaching-hospital areas have .37 percentage points lower mortality, and no higher rates of readmission with cardiac complications; high-risk patients from these areas have approximately the same mortality advantage, although they do suffer from higher complications rates. For low-risk patients, this quality advantage is achieved without any increase in expenditures; for high-risk patients, it is associated with an approximately 1.6 percent increase in total expenditures.

Hospital ownership affects medical expenditures, but not quality of care. For both high-risk and low-risk patients, areas with an above-median density of public hospitals provide more acute but less nonacute care; conversely, areas with an above-median density of private for-profit hospitals provide more nonacute but less acute care.

Areas with a high density of large hospitals provide more acute care to low-risk patients, but less acute (as measured in days) and less nonacute care to high-risk patients. For high-risk patients, this hospital-size-induced reduction in care has important outcome implications -- .44 percentage points higher mortality. Areas with a high density of system hospitals provide both less acute and less nonacute care to low-risk patients, but less acute and more nonacute care to high-risk patients. For low-risk patients, this hospital-system-induced reduction in care has small but statistically significant outcome implications – .15 percentage points higher rates of readmission with heart failure.

These estimated effects of competition and other market characteristics are not simply due to market size. The models underlying the estimates in table 2 control for both area bed capacity and population. Estimates of the effects of capacity and population are consistent with earlier work (Kessler and McClellan 2000), which finds that higher levels of bed capacity per patient (approximately equal to the difference between the coefficients on capacity and population from table 2) lead to significantly higher levels of expenditures, lower rates of cardiac complications, and higher rates of mortality.

III. Conclusion

Assessing the role of vertical differentiation in markets for hospital services is an important special case of a difficult general problem in industrial organization. Economic theorists have developed numerous models of the effects of competition on the distribution of qualities in a market, but the conclusions of these models are extremely sensitive to their underlying assumptions. More recently, empirical researchers have begun to investigate the consequences of competition for variety generally (see the literature review in Berry and Waldfogel 2003), but data limitations have made explicit welfare conclusions difficult (with some important exceptions, such as Berry and Waldfogel 1999). Because objective measures of health outcomes, such as mortality, are available in observational data bases, markets for health care provide an ideal case for study of this issue.

In this paper, we investigate the effects of competition on the level and dispersion of quality and expenditures with longitudinal data on virtually all non-rural elderly fee-for-service Medicare beneficiaries with a new occurrence of a heart attack (AMI) in 1985-1996. Our measure of dispersion is the difference in quality and cost between patients who have different severities of illness, and hence different valuations of quality, but are otherwise demographically and locationally similar. We separate patients into a low-risk or low-valuation and a high-risk or high-valuation group based on the presence of acute care hospital utilization in the year prior to AMI (approximately 30 percent of elderly AMI patients have prior-year hospital utilization); we control for patient characteristics, the characteristics of area hospital markets, and area fixed-effects.

We find that low-risk patients in less-competitive markets receive more intensive treatment than in more-competitive markets, but have statistically similar health outcomes. In contrast, high-risk patients in less-competitive markets receive less intensive treatment than in more-competitive markets, and have significantly worse health outcomes. Since this competition-induced increase in variation in expenditures is, on net, expenditure-decreasing and outcome-beneficial according to the estimates in Table 2,[3] we conclude that it is welfare-enhancing.

These findings are inconsistent with conventional models of vertical differentiation, although they can be accommodated by more recent models. In conventional models, firms try to relax price competition though differentiation. This implies that oligopoly hospitals lower the quality of care for low-valuation patients in order to be able to charge their high-valuation counterparts more, leading less-competitive markets in general to have greater variation in

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[3]Based on 1996 average total hospital expenditures of (Table 1B), more concentrated markets lead to expenditure increases (decreases) of approximately $274 per low-risk (high-risk) patient (274 = .013*21,070 = .012*22,827), which implies an aggregate expenditure increase of approximately $110 per patient (110 = .7*274 - .3*274).

quality and expenditures. But empirically, oligopoly hospitals offer a lower quality of care for high-risk patients at lower cost, and offer their low-risk patients roughly the same quality at higher cost, leading less-competitive markets to have less variation in quality and cost.

The intuition in Anderson and De Palma (2001) explains how oligopoly could lead to lower levels of quality without an increase in its dispersion. Suppose that all hospitals were high-quality, and that this were optimal. If one hospital switched to being low-quality, both its revenues and costs would decline, but the remaining high-quality firms would raise their prices in the sub-game equilibrium, because of the decrease in competition. This secondary effect increases the low-quality hospital's profits since low- and high-quality goods are substitutes. Because the private decline in the profits of the switcher would be smaller than the social loss, it may be profitable to switch, even though it is not optimal. Since the same argument applies to all remaining firms, the level of quality could decline without an increase in its dispersion.

We find no evidence of a welfare downside to competition through increased wasteful treatment variation, as some theoretical models suggest. In addition to confirming that competition is socially beneficial on average (e.g., Kessler and McClellan 2000), we find no evidence that competition generates aggregate benefits at the expense of a subsample of patients.

If anything, bias due to endogeneity in our measure of illness severity – whether the patient had prior-year utilization – would lead us to the opposite conclusion. To the extent that competition affects utilization before the onset of illness the same way it affects post-onset utilization, higher levels of utilization in uncompetitive markets would lead marginally low-risk patients to be re-classified as high-risk (because they would be more likely to experience utilization in the year prior to their AMI). In this case, both low-risk and high-risk patients would appear to have better outcomes in uncompetitive markets.

Other market characteristics also affect variation in treatment, and in turn welfare, in hospital markets. The presence of for-profit hospitals in a market, for example, leads to market-wide reductions in various measures of the average level of treatment intensity, but no significant aggregate or differential (between high-risk and low-risk patients) increases in rates of adverse health outcomes. How competition and other market characteristics interact to affect variation in cost and quality, in a model with both horizontal and vertical differentiation, is an important topic for further study.

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Table 1: Descriptive Statistics of Patients

	1985			1996		
	low-risk	high-risk	difference	low-risk	high-risk	difference
AMI readmission rate in year aft AMI	5.4%	7.1%	1.7%	4.5%	6.9%	2.4%
HF readmission rate in year after AMI	6.2%	10.9%	4.7%	6.8%	13.3%	6.5%
mortality rate in year after AMI	36.2%	48.7%	12.5%	29.0%	43.7%	14.7%
Age	75.2	76.8	2.1%	76.6	78.1	2.0%
Black	5.3%	6.3%	1.0%	5.9%	8.2%	2.3%
Female	47.9%	53.4%	5.5%	49.1%	54.7%	5.6%
Total hospital expenditures	$13,733	15,447	12.5%	$21,070	$22,827	8.3%
In year after AMI (1993 $)	(12,412)	(15,095)		(20,785)	(22,626)	
Acute expenditures	$13,655	$15,270	11.8%	$19,467	$20,375	4.7%
In year after AMI (1993 $)	(12,238)	(14,905)		(18,706)	(19,967)	
Acute days	16.8	20.4	21.3%	13.3	16.9	27.1%
In year after AMI	(15.3)	(19.5)		(12.9)	(16.6)	
Nonacute expenditures	$119	$179	50.4%	$1,604	$2,452	52.9%
In year after AMI (1993 $)	(1,224)	(1,276)		(5,874)	(7,128)	
Nonacute days	2.0	2.7	32.3%	4.7	6.8	44.7%
In year after AMI	(10.0)	(12.8)		(13.4)	(16.9)	
N	108,626	49,441		111,370	44,337	

Notes: Standard deviations in parentheses. For 1985, number of patients = 158,067, number of zip codes = 7,048; for 1996, number of patients = 155,707, number of zip codes = 7,814.

Table 2: Effects of Hospital Market Competitiveness and Area Density of Hospital Characteristics on Medicare Utilization and Health Outcomes of AMI Patients, 1985-1996, Allowing Effects to Vary for Patients Who are High-risk and Low-risk at the Onset of Illness

	Dependent Variable							
	ln(total hospital expenditures)	ln(acute expends)	ln(acute days in hospital)	ln(nonacu te expends)	ln(nonacute days in hospital)	AMI readmit w/in 1 year	HF readmit w/in 1year	dead w/in 1 year
High-risk at onset of illness	8.324**	7.088**	9.845**	31.083**	11.525**	1.366**	4.829**	10.968**
	(0.713)	(0.714)	(0.784)	(1.770)	(0.668)	(0.180)	(0.221)	(0.368)
Effects of competition and area hospital characteristics for low-risk patients								
Very concentrated hospital market	1.274**	1.055**	0.555	7.219**	2.353**	-0.014	0.071	0.221
(Top quartile of HHIs)	(0.525)	(0.526)	(0.577)	(1.303)	(0.492)	(0.132)	(0.162)	(0.281)
Concentrated hospital market	0.955**	0.803**	-0.031	4.375**	1.258**	-0.101	0.000	-0.083
(Middle two quartiles of HHIs)	(0.382)	(0.382)	(0.420)	(0.947)	(0.657)	(0.096)	(0.118)	(0.197)
Above median density of	0.666**	0.692**	0.101	-0.779	-0.218	0.074	-0.011	0.039
large hospitals [median = .220]	(0.319)	(0.319)	(0.351)	(0.792)	(0.299)	(0.080)	(0.099)	(0.165)
Above median density of	-1.320**	-1.398**	0.292	2.938**	1.484**	0.057	0.170	0.093
for-profit/non-profit [median = .012]	(0.381)	(0.382)	(0.419)	(0.947)	(0.357)	(0.096)	(0.118)	(0.197)
Above median density of	0.833**	0.956**	-0.006	-1.632*	-0.216	0.028	0.006	0.213
public/non-profit [median = .029]	(0.354)	(0.354)	(0.389)	(0.879)	(0.332)	(0.089)	(0.109)	(0.183)
Above median density of	-0.031	-0.186	-0.640*	3.352**	0.846**	-0.055	0.038	-0.365**
teaching hospitals [median =.141]	(0.302)	(0.303)	(0.332)	(0.750)	(0.283)	(0.076)	(0.094)	(0.156)
Above median density of	-1.335**	-1.225**	-0.748**	-1.377**	-0.334	-0.063	0.149*	-0.136
system hospitals [median = .525]	(0.262)	(0.262)	(0.288)	(0.649)	(0.245)	(0.066)	(0.081)	(0.135)
Bed capacity	0.047**	0.051**	0.038**	-0.060**	-0.020**	-0.002**	0.001	0.000
	(0.003)	(0.003)	(0.004)	(0.008)	(0.003)	(0.001)	(0.001)	(0.001)
Population (# of AMI patients)	-0.042**	-0.040**	-0.024**	-0.018	0.005	0.008**	0.000	-0.012**
	(0.006)	(0.006)	(0.007)	(0.016)	(0.006)	(0.002)	(0.002)	(0.003)

Table 2 (continued): Effects of Hospital Market Competitiveness and Area Density of Hospital Characteristics on Medicare Utilization and Health Outcomes of AMI Patients, 1985-1996, Allowing Effects to Vary for Patients Who are High-risk and Low-risk at the Onset of Illness

	Dependent Variable							
	ln(total hospital expenditures)	ln(acute expends)	ln(acute days in hospital)	ln(nonacute expends)	ln(nonacute days in hospital)	AMI readmit w/in 1 year	HF readmit w/in 1year	dead w/in 1 year
Effects of competition and hospital characteristics for high-risk patients								
Very concentrated hospital market	-1.235**	-1.385**	-2.649**	2.974**	0.933**	-0.135	-0.592**	0.822**
(Top quartile of HHIs)	(0.619)	(0.619)	(0.680)	(1.536)	(0.580)	(0.156)	(0.191)	(0.319)
Concentrated hospital market	-1.512**	-1.683**	-2.325**	4.593**	1.263**	-0.233**	-0.349**	0.496**
(Middle two quartiles of HHIs)	(0.446)	(0.447)	(0.491)	(1.107)	(0.418)	(0.112)	(0.138)	(0.230)
Above median density of	-0.103	0.272	-1.297**	-5.677**	-2.261**	0.132	-0.198	0.439**
large hospitals [median = .220]	(0.426)	(0.426)	(0.468)	(1.056)	(0.399)	(0.107)	(0.132)	(0.220)
Above median density of	-1.498**	-1.827**	0.716	8.484**	2.838**	0.008	0.055	0.166
for-profit/non-profit [median = .012]	(0.442)	(0.442)	(0.486)	(1.096)	(0.414)	(0.111)	(0.137)	(0.228)
Above median density of	1.264**	1.522**	-0.588	-2.190**	-0.500	0.036	-0.029	0.334
public/non-profit [median = .029]	(0.411)	(0.411)	(0.452)	(1.020)	(0.385)	(0.104)	(0.127)	(0.212)
Above median density of	1.628**	1.167**	1.358**	8.788**	2.843**	0.329**	0.489**	-0.374*
teaching hospitals [median =.141]	(0.385)	(0.386)	(0.424)	(0.956)	(0.361)	(0.097)	(0.119)	(0.199)
Above median density of	-2.880**	-3.153**	-1.607**	7.605**	2.401**	0.012	0.046	0.208
system hospitals [median = .525]	(0.327)	(0.327)	(0.359)	(0.811)	(0.306)	(0.082)	(0.101)	(0.169)
Bed capacity	0.058**	0.066**	0.037**	-0.159**	-0.051**	-0.004**	-0.002	0.000
	(0.004)	(0.004)	(0.004)	(0.010)	(0.004)	(0.001)	(0.001)	(0.002)
Population (# of AMI patients)	-0.047**	-0.052**	0.025**	0.131**	0.054*	0.015**	0.015**	-0.012**
	(0.007)	(0.007)	(0.008)	(0.018)	(0.007)	(0.002)	(0.002)	(0.004)

Note: All coefficients multiplied by 100 to facilitate interpretation, so coefficients from regressions in logarithms represent approximate percentage changes, and coefficients from outcome models represent percentage point changes. Estimates calculated controlling for 5 digit zip code fixed effects. N=1,736,167.