Competition and the Cost of Capital Revisited: Special Authorities and Underwriters in the Market for Tax-exempt Hospital Bonds

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Abstract *- We explore the effects of two kinds of competition on the cost of capital in the tax-exempt bond market: (1) competition among underwriters and (2) competition among issuers (mostly quasi-government special authorities). The first kind of competition—competitive versus negotiated bidding processes—has received considerable previous attention. The second kind of competition has received far less attention and is related to the level of decentralization of the market for issuing bonds. Using a national database covering 14 years, we find that both kinds of competition lower interest rates, at least in the hospital sector.*

INTRODUCTION

This study explores the effects of two different kinds of competition on the cost of capital in the tax-exempt bond market: (1) competition among underwriters and (2) competition among issuers. The first kind of competition—essentially, competitive versus negotiated bidding processes—has received considerable attention in the literature. The second kind of competition, the number of potential issuers available to a beneficiary of a bond issue, has received far less attention. Most bond issues are now done through special authorities sanctioned by state governments, and some states allow more competition among these authorities than others; consequently, the bond market in some states is more concentrated than in others. Studies of the effects of competition have often used small samples of bond issues—often in one or a few states and for one or a few years—to reach their conclusions. This study presents results based on a large and comprehensive database for tax-exempt hospital bonds from 1980 to 1993 in all 50 states and the District of Columbia.[1]

[1] Simonsen and Robbins (1996) have 210 observations for the state of Oregon for 1992–93. Bland (1985) has 330 observations for the state of Pennsylvania with additional information from New Jersey and Ohio for 1976–78. Roden and Bland (1986) have 121 observations for Pennsylvania for 1978–80. Bland (1984) has 874 observations for ten Northeastern states for 1976–78. Kidwell and Rogowski (1983) have 615 observations for New England states for 1970–76. Leonard (1996) uses 2,333 observations of all municipal

Regarding competition among underwriters, earlier investigations (e.g., Kessel, 1971; Joehnk and Kidwell, 1979; Kidwell and Rogowski, 1983) tended to find higher costs through negotiated bidding processes. Some later studies (Bland, 1984; 1985) assert that mitigating circumstances, such as the level of an issuer's experience, help off-set the costs from a lack of competition. Finally Simonsen and Robbins (1996) found that, for the State of Oregon, the cost of capital for competitive sales was lower compared to negotiated sales. Perhaps the lone dissenter is Leonard (1996), who finds "no difference in reoffer yields due to method of sale" (1996, p. 66).

Regarding competition among issuers, Hildreth (1993, p. 44) paints an excellent descriptive picture of the bond-issuing environment and mentions "the extensive expansion of special districts and other statutory authorities," but neither he nor other analysts have provided systematic explorations of the impact that levels of competition inherent in state-level tax-exempt bond markets have on the cost of capital.[2] In fact, despite some promising trends to the contrary, Poterba's (1991, p. 1) assertion that "the tax-exempt bond market has received relatively little attention from academic economists," remains true, especially considering the size and importance of the market. This study continues the debate over the impact of competition in the municipal bond market and, using a national database covering fourteen years, finds that both kinds of competition do in fact lower borrowing costs, at least in the hospital sector.

COMPETITION IN STATE-LEVEL BOND MARKETS AND THE ROLE OF SPECIAL AUTHORITIES

Municipal bonds are generally issued either (1) by state and local governments or (2) by quasi-government entities usually known as financing authorities (e.g., the New York State Dormitory Finance Authority or the Texarkana Health Facilities Development Corporation). Finance Authorities are created by state and local governments specifically to issue tax-exempt bonds. The generic term for both types is "financing agency," and we use the word "authorities" to refer specifically to the quasi-government entities. Approximately two-thirds of all municipal bond financings 1980–1993 were originated by financing authorities. For hospital bonds, the figure is 80 percent.

Hildreth (1993, 44) explains the popularity of finance authorities as a critical component of "avoidance strategies" that state and local governments use to overcome "structural hurdles" in the process of financing infrastructure:

> "... [Finance Authorities are] often termed off-budget entities—empowered to issue revenue bonds without placing at direct risk the taxing capacity, or full-faith-and-credit guarantee. In fact, many off-budget entities serve as 'conduits,' defined as a governmental issuer of securities with an ultimate credit source being a private profit-making or nonprofit organization [e.g., a hospital]."

In some cases the authorities are simply conduits for financings, doing no more than issuing bonds, turning the proceeds

bond issues reported in the *Bond Buyer* from August through December of 1992. Kessel's (1971) seminal study had 8,614 observations for all 50 states for 1959–1967. Our analysis is based on 4,576 observations for hospital bonds in all 50 states and the District of Columbia for 1980–93. Thus, our results are generalizable within the hospital bond sector and perhaps to other sectors that rely heavily on revenue bonds sold primarily through negotiation.

[2] For additional overview of the institutional and incentive environment in the municipal bond market see Petersen (1991).

over to the project beneficiary, and often ceasing to exist once the financing is complete. In other cases, the authorities may become permanent state or local agencies, actively pursuing and shaping projects and working with potential beneficiaries to plan capital projects. Authorities may help governments circumvent debt caps and requirements for referenda. They may also help them provide services now for which the bills will come due later.[3] Not surprisingly, they have become the preferred means through which to finance hospitals and other health care capital, as we show below.

While hospitals and other private profit-making or nonprofit organizations receive the proceeds from bond offerings, they do not issue or sell the bonds. The bonds are issued on their behalf by a financing agency and sold to (or by) an underwriter (i.e., an investment banker) who in turn resells them. Proceeds from the bond sale are then transferred to the beneficiary, on whose behalf the bonds were issued, to meet the purpose of the bond offering.[4]

On a state or local basis there may be more than one financing agency from which the beneficiary is permitted to choose. Presently, in the health care capital finance industry, there are 12 states with hospital finance authorities that have monopolies for issuing tax-exempt bonds. There are 19 states where hospitals can select from state-level authorities or an alternative, local issuer. The remaining states have only non-state-level issuers.[5] We hypothesize that these different regimes differ in the extent to which competition exists among issuers, and we test if this affects the cost of capital.

The policy regime for health care capital finance is set at the state level, and varies greatly from state to state. This variation occurs with respect to two main characteristics: (1) the extent to which financing is centralized at the state level or decentralized either to the local level or to several different state-level authorities and (2) the extent to which financing is performed by government or quasi-government entities (authorities). Table 1 provides a snapshot of the bond market in several states in 1980 and 1993. In 1993 for instance, of the 80.1 percent of par value of health care bonds issued through special authorities nationally, 44.7 percent was issued by local (sub-state level) authorities, while 55.3 percent was issued by state-level authorities. Of the 19.9 percent issued directly by governments, 95.3 per-

[3] In a more general sense, Foster (1997, chapter 6) has argued that special purpose government is more costly than pure government provision of services.

[4] This procedure is necessary in order to satisfy Internal Revenue Service rules allowing interest payments to pass to investors free from the federal income tax (i.e., tax advantaged). Tax advantaged bonds can be issued at lower interest rates than their taxable counterparts. For decades, state and local government agencies have used the proceeds from bond offerings to finance public healthcare and public hospital capital projects. However, in a 1963 ruling by the Internal Revenue Service, hospitals classified as 501 (C)-3 private, nonprofit institutions were permitted to issue tax-exempt bonds under the condition that the hospital transfers ownership to a unit of government when the debt is repaid. Thus, the voluntary hospital sector could finance capital projects with tax-exempt debt, although the nonprofit hospitals did not view tax-exempt financings favorably. Hospitals needed to find a mechanism which would allow tax-exempt bonds to be issued on their behalf on more favorable terms. Of course, a mechanism was developed, although we have not seen references to its origins. Typically, the procedure for financing through an authority is as follows: The financing authority is given title to the facility for the life of the bond issue and leases it back to the healthcare institution. The institution, in turn, pays rent on the lease that is equal to the debt service on the bond. In addition to leaseback arrangements, this may be accomplished by loan or installment sale mechanisms. When the bond is retired, ownership title returns to the healthcare institution.

[5] The 12 Monopoly states are CO, CT, ID, MA, MD, MT, NH, RI, SD, VT, and WA. The 19 states with state-level and local authorities are AZ, CA, DE, GA, IL, IN, KY, LA, MI, MO, MS, NC, NE, NJ, NY, OK, TX, WI, and WV. The District of Columbia is counted as a state regime in this study.

TABLE 1
TAXONOMY OF ISSUER TYPES IN SELECTED STATES 1980 AND 1993[a]

State	Quasi-Public Authority Share of Total Health Care Bond Market (%)		Local Authority Share of Total Quasi-Public Bond Issues (%)		Local Government Share of Total Government Issues (%)	
	1980	1993	1980	1993	1980	1993
Texas	100	100	100	90.2	n/a	n/a
Florida	93.3	69.5	100	100	100	100
Mass.	100	81.7	0	0	n/a	100
R.I.	100	100	0	0	n/a	n/a
Conn.	100	97.1	0	0	n/a	100
California	72.8	70.5	100	31.1	100	100
Colorado	80.0	85.6	0	16.4	100	100
New York	100	93.7	0	20.5	n/a	100
Illinois	77.3	92.8	0	0.1	100	100
Indiana	88.4	92.8	100	27.3	100	100
Ohio	0	11.4	n/a	80.2	72.9	88.7
50 state average[b]	69.3	80.1	47.5	44.7	87.7	95.3

[a]n/a indicates that there were no relevant issues; thus the proportion would be 0/0.
[b]50 state average includes District of Columbia.

cent was issued locally. And, there is great variation between states in these figures. For example, all bonds in Texas in 1993 were issued by quasi-government authorities, and 90 percent through local authorities. In California 70 percent were issued by quasi-government authorities, but only 31 percent through local authorities. In Rhode Island, all health care bonds were issued by a single, state-level authority. In this study we focus on hospitals rather than on the entire health care bond market, and we focus on the impact of the concentration of the bond market in one, a few, or many potential issuers within a state.

The financing agencies are responsible for matching hospitals with underwriters. Although it is the hospital that ultimately agrees to an underwriter, the financing agency usually chooses the pool of underwriters from which the hospital must select. So, the hospital chooses the financing agency (which as noted is a virtual statewide monopoly in 12 states), and then the hospital chooses an underwriter based on those acceptable to the financing authority.[6] Also, the financing agency can influence and may even decide whether the bond deal will proceed as a competitive issue (based on sealed bids by acceptable underwriters), a negotiated issue (where the hospital chooses a particular underwriter from a pool of acceptable ones), or a private placement (where the underwriter is bypassed altogether).

The other kind of competition we examine, thus, is among investment bankers for deals. Previous analyses provide some evidence that competition among bankers (competitive bidding for underwriting opportunities as opposed to ne-

[6] It is common in the literature to discuss the "search" processes involved in bond issues (e.g., Bland, 1985). Most of these discussions detail the importance of issuer search for underwriters (for negotiated sales) and underwriter search for investors. It is important to note that this search process is really more complex for hospital bonds. The underwriters search for investors much as described in Bland (1985). Beneficiaries search for a finance authority. They also search for an underwriter, but the finance authority may help or even dominate this search. In our discussion, we refer to finance authorities as issuers and hospitals as beneficiaries. When governments issue bonds directly—that is, not through a special authority—they are generally both the beneficiary and the issuer. This is not the case for most hospital bond issues, or for most bond issues that use a special authority. Thus, our study lends insight into deals done through special authorities in which the search incentives may be skewed by the fact that the beneficiary and the issuer are not the same entity. This is particularly important given the fact that special authorities that issue bonds (unlike issues in which both the beneficiary and the issuer are the same) charge fees, and these fees are part of the cost of providing public goods and services.

gotiated deals) lowers the costs of capital in the hospital bond market. But competition among underwriters is not entirely absent in a negotiated deal because the lead underwriter is selected from a potential pool. It has become evident to us from our work and discussions with those involved in bond issues that the financing authority is often the locus of this competition. Indeed, as mentioned above, some authorities dictate the selection of a lead underwriter while others severely limit the number of potential lead underwriters among which the hospital must choose. It is plausible that the ability of an authority to limit the pool of underwriters is inversely related to the amount of competition that it faces.

The negotiated method is employed in approximately 93 percent of all issues of tax–exempt hospital bonds.[7] Typically, interest rates on competitive issues are lower than on negotiated issues. Possibly this occurs because negotiated underwriters offer more services to the issuer (Sorensen, 1979). Negotiated hospital bond financings and private placements may also be riskier, more complex and may require more inputs from underwriters than similar corporate bond financings (Leonard, 1996). Part of these differentials, however, can also be due to the absence of competitive market forces in negotiated deals and private placements (Kessel, 1971). The plausibility of this argument is underscored by several scandals involving the issuance of negotiated municipal bonds, for instance in New Jersey in 1993. These scandals led then Governor Jim Florio to issue an executive order requiring that underwriters on future state bond deals be chosen by competitive bidding unless a strong justification could be made for another method of selection (Spiro, Light, Hawkins, and Smith, 1993). Of course, there are myriad examples that have raised similar concerns, such as the yield burning accusations of the early 1990s. Finally, as Roden and Bland (1986) and Bland (1985) explain, inexperienced and unsophisticated issuers may negotiate poorly. Again, we test if the choice of competitive or negotiated bidding processes affects the cost of capital.

DATA

The data used in this study are derived from a data base we have constructed of all new issues of municipal health care securities from 1980–93. New issues include new financings whose proceeds are used to invest in land, plant, and fixed and moveable equipment and refinancings whose proceeds are used to retire existing debt prior to maturity. Among refinancings, there is a category called advance refundings. Here the proceeds of a current bond issue are used to generate investment yield which, when combined with those proceeds, is sufficient to meet the interest payments and principal of an earlier bond issue. This is necessary when there is sufficient economic incentive for prepayment, but the earlier issue contains provisions which limit prepayment.

The data were purchased from Securities Data Company (SDC) and each bond issue is an observation. The entire database includes 8,482 health care bond issues, including hospitals, nursing homes, and life care/retirement facilities. The

[7] This figure includes private placements. The sum of the underwriter's costs and profit is termed the gross spread. In a competitive deal the underwriter covers costs and makes a profit by purchasing the bonds from the issuer at approximately par value and re–offering them above par. In a negotiated deal the underwriter does not directly purchase the bonds. Instead, it finds customers who purchase the bonds from the issuer at par. The underwriter then subtracts its costs and profit from the proceeds received by the issuer. In either case the beneficiary of the bond issue borrows at a higher interest rate than the rate received by the ultimate purchasers of the bonds. A negotiated deal may involve an original issue discount which further reduces the proceeds received by the issuer. This occurs when some bonds in the issue (usually the term bonds and the serials with relatively long maturates) are offered to the public at less than par value.

empirical analysis in this study is based on a data set of 6,701 new bond financings and refinancings for hospitals only. Data on issue characteristics are merged with hospital, national, state, and local market area characteristics from a variety of sources.

The true interest cost (TIC), or yield to maturity or internal rate of return, is the most widely used summary measure of the interest rate on a municipal bond issue from the borrower's point of view. This rate equates the proceeds received by the beneficiary to the present value of interest payments and principal repayments. The TIC is the measure we use for cost of capital, and it is the dependent variable in the empirical work that follows. Of the 6,701 hospital bond issues in the database, we can compute the TIC for 5,799 issues using a detailed algorithm described in Grossman et. al. (1993).

In order to compute most accurately the TIC, however, we needed to know the fees that were charged by the finance authorities. This information was not available, so we devised and implemented a national survey of all health care finance authorities to determine the level of fees charged. To obtain information on fees charged by issuers and changes in fees over time, we conducted a survey of all issuers classified as state authorities, local authorities, and districts. The survey universe consisted of 999 issuers. Those receiving questionnaires issued 4,824 bonds with a total real par value of $130 billion in 1982–84 dollars during the period 1980 through 1993. It included issues for whom we could not compute the TIC because that determination was not made until a later stage in the research. Note that this means that 1,877 issues (6,701 – 4,824) were done by issuers who did not need to be surveyed because, as pure governments, they do not charge fees. Of the 999 issuers in the survey, 359 returned the questionnaire. Thus, the response rate of 36 percent in terms of issuers was relatively modest. The respondents, however, accounted for 65 percent of all issues done by the survey universe and for 71 percent of their real par value. These response rates are much more impressive. They indicate that our survey includes most of the large issuers both in terms of the number of bond deals and their total par value. Clearly, the small issuers who responded to the survey may not be representative of the universe of all small issuers.

In principle the solution to potential biases due to nonresponse is to apply Heckman's (1979) sample selection methodology. In fact, identification of this model by means other than the nonlinear relationship between the inverse of the Mills ratio and the regressors in the TIC equation is unlikely. As shown by Leung and Yu (1996), the sample selection model is not well–behaved if the regressors in the selection equation (the equation determining the probability of responding to the survey in our case) and primary equation (here the equation determining the TIC) are identical. Given this and the lack of empirical research in the area at issue, we interpret our results as being conditional on the survey being returned.

Regressions were estimated with a sample drawn from the 5,799 issues where TICs exclusive of fees can be computed. Of these, 1,213 issues were done by state and local authorities who received the survey and did not respond and 10 were done by issuers who responded but did not report information on fees. Thus, the sample (n = 4,576) excludes these issues. Measures of the number of issuers and the concentration of par value among issuers in state–level bond markets are based on all 6,701 hospital issues in the full data base. The mean and standard deviation of the dependent variable, the true interest cost inclusive of fee in the sample, are 8.22 percent and 2.34 percent, respectively. Table 2 presents the definitions, means, and standard deviations of the independent variables.

TABLE 2
DEFINITIONS, MEANS, AND STANDARD DEVIATIONS OF VARIABLES
(ENTIRE SAMPLE OF 4,576 ISSUES. FIRST FIGURE IS MEAN; SECOND IS STANDARD DEVIATION)

A. Issue and Issuer Characteristics	
TIC (8.222, 2.340)	True interest cost as a percentage
Negotiated (0.903, 0.295) Private placement (0.028, 0.164)	Dichotomous variables that identify negotiated issues and private placements, respectively; omitted category pertains to competitive issues
Call (0.852, 0.355)	Dichotomous variable that identifies callable issues
Put (0.101, 0.302)	Dichotomous variable that identifies putable issues
Fixed (0.888, 0.316)	Dichotomous variable that identifies issues with fixed coupon rates
Length (24.464, 9.036)	Length in years between the date of final maturity and the date of issue
Pool (0.059, 0.235)	Dichotomous variable that identifies pooled financings
Rank (10.673, 13.131)	Rank of primary underwriter in terms of total par value of issues underwritten; ranges from 1 (highest par value) to 50 (lowest par value)
No rank (0.250, 0.433)	Dichotomous variable that identifies issues in which primary underwriter is not one of the 50 leading underwriters
General (0.087, 0.282)	Dichotomous variable that identifies general obligation bonds
Issuer's number of previous issues (25.756, 43.909)	Total number of previous issues by issuer; includes nursing home and life care issues
S&P AAA (0.346, 0.476) S&P AA (0.084, 0.278) S&P A (0.204, 0.403) S&P other (0.080, 0.272)	Dichotomous variables that identify issues rated by Standard and Poor's as AAA (S&P AAA); AA+ or AA– (S&P AA); A+ or A– (S&P A); or below A– (S&P other); omitted category pertains to unranked issues
Moody high (0.115, 0.319) Moody low (0.241, 0.428)	Dichotomous variables that identify issues rated higher by Moody's than by Standard and Poor's or lower by Moody's than by Standard and Poor's, respectively
Refinancing (0.269, 0.444)	Dichotomous variable that identifies issues that are refinancings or advance refundings
Real par (26.297, 34.248)	Real par value of issue in millions of 1982–84 dollars
Real par squared (1864.17, 8829.09)	Square of real par value
B. National Characteristics	
T bond rate (9.030, 1.976)	Yield on 30–year U.S. Treasury bond on week of issue as a percentage
Variability (0.170, 0.114)	Standard deviation of previous variable based on an eight–week period ending with the week of issue
C. State Characteristics	
State income tax (0.055, 0.035)	State income tax rate in highest tax bracket as a fraction
Mandatory rate setting (0.121, 0.324)	Dichotomous variable that identifies issues in states with mandatory rate–setting programs

TABLE 2 (continued)
DEFINITIONS, MEANS, AND STANDARD DEVIATIONS OF VARIABLES
(ENTIRE SAMPLE OF 4,576 ISSUES. FIRST FIGURE IS MEAN; SECOND IS STANDARD DEVIATION)

C. State Characteristics (*continued*)	
Concentration ratio (–0.220, 0.270)	Natural logarithm of four largest issuer concentration ratio based on real par value in issue year; logarithm of fraction of real par value accounted for by four largest issuers
Herfindahl index (–1.094, 0.812)	Natural logarithm of Herfindahl index based on real par value; logarithm of sum of squared share of each issuer in total real par value
Total real municipal bond financings (4,978.53, 5,326.90)	Year– and state–specific total real municipal bond financings in millions of 1982-84 dollars
D. County Characteristics	
Unemployment[a] (7.277, 2.950)	Unemployment rate of persons aged 16 and over as a percentage
Rural[a] (0.193, 0.385)	Dichotomous variable that identifies rural counties
E. Hospital Characteristics	
Multi (0.226, 0.418)	Dichotomous variable that identifies issues for multihospital systems
Teach (0.129, 0.335)	Dichotomous variable that identifies issues for hospitals that have teaching status
Medicare share[a] (0.446, 0.136)	Fraction of inpatient days accounted for by Medicare inpatient days
Medicaid share[a] (0.097, 0.092)	Fraction of inpatient days accounted for by Medicaid inpatient days
Asset ratio[a] (2.180, 1.788)	Ratio of total assets to total liabilities
Medicare share*PPS[a] (0.036, 0.099)	Fraction of inpatient days accounted for by Medicare inpatient days multiplied by PPS profitability margin (PPS); interacted with a dichotomous variable that equals 1 for the years 1984 through 1993 since PPS began in October 1983
Medicaid share*DRG[a] (0.025, 0.058) Medicaid share*other[a] (0.034, 0.074)	Fraction of inpatient days accounted for by Medicaid inpatient days multiplied by a dichotomous variable that identifies issues in states using a DRG reimbursement methodology under Medicaid (Medicaid Share*DRG) and fraction of inpatient days accounted for by Medicaid inpatient days multiplied by a dichotomous variable that identifies issues in states using a Medicaid reimbursement system with prospective rate of increase controls or with negotiation and fixed contracting (Medicaid Share*other); omitted category pertains to issues in states using retrospective cost–based reimbursement under Medicaid
Operating margin[a] (0.008, 0.058)	Net patient revenue minus operating expenses divided by net patient revenue
Hospital's number of previous issues[a] (1.969, 4.579)	Total number of previous issues in which hospital was the beneficiary
F. Unknowns	
Hospital's number of previous issues unknown (0.141, 0.348)	Hospital name unknown; this variable and the next four are dichotomous indicators

TABLE 2 (continued)
DEFINITIONS, MEANS, AND STANDARD DEVIATIONS OF VARIABLES
(ENTIRE SAMPLE OF 4,576 ISSUES. FIRST FIGURE IS MEAN; SECOND IS STANDARD DEVIATION)

F. Unknowns (*continued*)	
Asset ratio unknown (0.286, 0.452)	Value of the asset ratio is unknown
PPS margin unknown (0.407, 0.491)	Includes cases where PPS margin is known but Medicare share is unknown
Operating margin unknown (0.345, 0.475)	Value of the operating margin is unknown
Other variable unknown (0.277, 0.448)	Identifies issues in which the unemployment rate, the rural indicator, the fraction of Medicare patients days, and the fraction of Medicaid patient days are unknown; if one variable is unknown, all are unknown

[a]Mean and standard deviation pertain to issues for which variable is known.

ANALYTIC AND CONCEPTUAL FRAMEWORK AND MEASUREMENT OF VARIABLES

We use multiple regression techniques to examine the effects of competition, risk,[8] the general level of interest rates, issuance costs, and government regulations[9] on the TIC for tax–exempt hospital bonds issued from 1980 through 1993. Except in the case of competition among issuers, we adopt an analytical framework similar to the one contained in Grossman et. al. (1993). That study did not consider the role of issuers and was limited to SDC data on hospital bonds for the years 1980 through 1988. In this section we focus on the effects of issuer concentration and competitive bidding processes, and then we discuss briefly the roles of other variables. A more detailed treatment of this is contained in Grossman et. al. (1993).

Measures of State–level Market Concentration

To motivate our measures of the prevalence of issuers and the concentration of issues among them, we sketch out some elements of a simple model of the behavior of authorities. While authorities are nonprofit organizations, we assume that their aim is to maximize their income. There is little consensus with regard to the objectives of nonprofits, and the assumption of income maximization often is consistent with and gives the same predictions as the assumption that a more complicated objective function is being maximized. We also assume a market structure characterized by oligopoly. This is natural since we want to consider the effects of variations in such variables as the number of firms in the industry and the concentration in production among firms.

We incorporate two widely used measures of concentration: the four–firm concentration ratio and the Herfindahl index (for example, see Tirole, 1988; Scherer and Ross, 1990). The concentration ratio is defined as the fraction of industry output accounted for by the four largest producers. The Herfindahl index is defined as the sum of the squared share of each producer in total output. It ranges from 1 in the case of pure monopoly to $1/n$ in the case of n firms, each of which produces the same

[8] There are two types of risk: institutional risk—which is specific to the issuer of the bond—and market risk. An example of the former is default. Market risk arises because of uncertainty about future interest rates. Our analytical framework incorporates both types of risk.

[9] The main government regulations at issue in our research, which we discuss in the appropriate subsections below, are the Federal tax reform legislation enacted by Congress in September 1986 and Medicare and Medicaid reimbursement policies and changes in these policies during the period we analyze.

output. The fewer are the number of firms and the more concentrated output is among them, the larger is the value of the index. Suppose that the output of the i^{th} authority in the j^{th} state is measured by the par value of the number of bonds that it issues in a given year (B_{ij}). The authority faces a demand function for par value of the form:

$$[1] \quad B_{ij} = B_{ij}(f_{ij}, t_{ij}),\ \partial B_{ij}/\partial f_{ij} < 0,\ \partial B_{ij}/\partial t_{ij} < 0.$$

Here f_{ij} is the fee charged by the authority to the beneficiaries of its bonds (the hospitals) and t_{ij} is the true interest cost of the issue exclusive of fee. The authority's total cost function is given by:

$$[2] \quad C_{ij} = C_{ij}(B_{ij}, t_{ij}),\ \partial C_{ij}/\partial B_{ij} > 0,\ \partial C_{ij}/\partial t_{ij} < 0.$$

It is straightforward to let total cost depend on output (par value) and to let the marginal cost of producing output ($\partial C_{ij}/\partial B_{ij} \equiv c_{ij}$) be positive. We also assume, however, that the authority can obtain a lower TIC exclusive of fee for the beneficiary by allocating resources to this activity. Efforts to lower the TIC could take the form of maintaining a large pool of underwriters, advising the hospital with regard to the ability of alternative underwriters, trying to match the hospital with the underwriter who will charge the smallest gross spread, and working with the hospital to obtain favorable credit ratings. Viewed in this manner, the TIC exclusive of fee is analogous to quality; a reduction in t_{ij} corresponds to an increase in quality. Indeed, reductions in the TIC may be accompanied by the provision of services valued by the hospital that do not necessarily translate into a lower TIC. Examples are advice with regard to staffing patterns, assistance with project development, and provision of financial and legal services.

If q_{ij} denotes the services just mentioned, a more complete specification of the demand function is:

$$[3] \quad B_{ij} = B_{ij}[f_{ij}, t_{ij}, q_{ij}(t_{ij})],\ \partial B_{ij}/\partial q_{ij} > 0,\ \partial q_{ij}/\partial t_{ij} < 0.$$

To allow for the presence of services summarized by q_{ij}, we do not assume that the demand function depends simply on the true interest cost inclusive of fee. Models in which firms engage in quality competition have some of the same properties as models in which firms engage in advertising competition. Therefore, we can draw on this literature to make predictions about what happens to the TIC exclusive of fee as concentration or the number of rivals varies.

The authority's income (Y_{ij}) is:[10]

$$[4] \quad Y_{ij} = f_{ij}B_{ij}(f_{ij}, t_{ij}) - C[B_{ij}(f_{ij}, t_{ij})]$$
$$= f_{ij}(B_{ij}, t_{ij})B_{ij} - C(B_{ij}, t_{ij}).$$

The conditions that must be satisfied to maximize income with respect to B_{ij} and t_{ij} or with respect to f_{ij} and t_{ij} are

$$[5] \quad f_{ij}[1 - (\varepsilon_{ij})^{-1}] = c_{ij}$$

$$[6] \quad (\partial B_{ij}/\partial t_{ij})(f_{ij} - c_{ij}) = B_{ij}(\partial f_{ij}/\partial t_{ij}) = \partial C_{ij}/\partial t_{ij}.$$

Here $\varepsilon_{ij} = -(\partial B_{ij}/\partial f_{ij})(f_{ij}/B_{ij})$ is the price elasticity of demand of par value with respect to the fee.

Equation [5] is the familiar condition that marginal revenue must equal marginal cost. To use it to generate relationships between the fee and the number of issuers or the concentration of par value among issuers, assume that the TIC exclusive of fee is exogenous. In addition, suppose that the industry can be characterized by the pure version of the Cournot model of oligopoly. In that version, a firm

[10] In the middle term in the formula for income, f_{ij} and t_{ij} are taken as the decision variables. In the last term, B_{ij} and t_{ij} are taken as the decision variables. Given f_{ij} and t_{ij}, B_{ij} is determined from the demand function. Given B_{ij} and t_{ij}, f_{ij} is determined from the inverse demand function.

picks its optimal output under the assumption that other firms will continue to produce their current output levels. Hence $f_{ij} = f_j$ and:

$$[7] \quad \varepsilon_{ij} = (B_j / B_{ij})\varepsilon_j = (k_{ij})^{-1}\varepsilon_j,$$

where B_j is total output in the industry (total par value in the state), ε_j is the price elasticity of demand at the industry level, and $k_{ij} = (B_{ij}/B_j)$ is the fraction of total par value accounted for by the ith issuer.

If the marginal cost of issuing bonds (c_{ij}) is independent of B_{ij} and does not vary among authorities ($c_{ij} = c_j$), the equilibrium fee is given by:

$$[8] \quad f_j = [(n_j\varepsilon_j/(n_j\varepsilon_j - 1)]c_j,$$

where n_j is the number of authorities in the state. Clearly, the fee falls as the number of authorities rises. If c_{ij} varies among authorities, the equilibrium fee can be written:

$$[9] \quad f_j = [\varepsilon_j/(\varepsilon_j - h_j)]c_j^*,$$

where h_j is the Herfindahl index and c_j^* is an output–share (k_{ij}) weighted average of the marginal cost of each producer.[11] According to equation [9], the fee rises as the Herfindahl index rises.

Now turn to equation [6] for the optimal TIC exclusive of fee. This condition is identical to one determining the optimal amount of advertising or the optimal amount of quality, with t_{ij} interpreted as a negative correlate of quality or advertising. A familiar result from the economics of advertising is that advertising falls as the price elasticity of demand rises; less competitive firms have more incentives to advertise or to raise quality. (Dorfman and Steiner, 1954). This can be seen by using equation [5] to rewrite the first term in equation [6] as:

$$[10] \quad m_{ij} = (f_{ij}/\varepsilon_{ij})(\partial B_{ij}/\partial t_{ij}).$$

This term defines the marginal revenue (m_{ij}) obtained by the authority from lowering the TIC exclusive of fee. With the fee and the increase in demand due to a lower TIC held constant, marginal revenue falls as the elasticity of demand faced by the issuer rises. This elasticity is positively related to the number of issuers and negatively related to industry concentration in the simple Cournot model and in more complicated models that take account of reactions by rivals and product differentiation. Thus it would appear that the lower fees that accompany increases in issuers and reductions in competition may be offset by increases in TICs exclusive of fees.

The preceding conclusion has been challenged in an important paper by Becker and Murphy (1993). They argue that increases in a given firm's elasticity of demand that accompany increases in competition and in the number of rivals raise the marginal product of quality or advertising (raise the absolute value of $\partial B_{ij}/\partial t_{ij}$ in our context). This is because expansions in advertising or quality attract customers from competitors as well as raising the quantity demanded by existing customers. The potential to attract customers from rivals is greater as the number of firms that compete with the firm in question rises. Becker and Murphy's model is consistent with the widely held view that oligopolistic industries advertise more than monopolistic industries and that competitive producers make better quality products than monopolistic producers.

We adopt Becker and Murphy's assumption that an increase in the number of issuers in a state or a reduction in the

[11] For derivations of equations [8] and [9], see Tirole (1988) and Scherer and Ross (1990). If marginal cost does not vary among firms and the industry demand function is linear, the optimal fee is:

$$f_j = (a_j + c_j n_j)/(n_j + 1),$$

where a_j is the ratio of the intercept to the absolute value of the slope of the demand function.

concentration of par value among them raises the marginal product of a reduction in the TIC in absolute value at the same time as it increases the price elasticity of demand for par value. If the former effect exceeds the latter effect in percentage terms, the optimal TIC exclusive of fee (t_{ij}) falls. Our working hypothesis is that the TIC does in fact fall, although we realize that this need not be the case.[12]

To summarize, we have used models of Cournot behavior and advertising/quality competition to generate hypotheses about the relationship between issuer fees and concentration or the number of firms and between the true interest costs exclusive of fees and concentration or the number of issuers. In more complicated models of oligopoly behavior than the pure Cournot model, the Herfindahl index is not necessarily the best measure of concentration (Kwoka, 1981, 1985; Wiriyawit and Veendorp, 1983; Sleuwaegen and Dehandschutter, 1986). Therefore, we also measure concentration by the fraction of real par value accounted for by the four largest issuers (the concentration ratio). For both concentration measures annual real par value is used as output in this context.[13] We compute these measures at the state level based on the number of bonds issued each year, and the value is the same for each issue in a given state in a given year.

The natural logarithm of the concentration ratio or the natural logarithm of the Herfindahl index is used as alternative measure of concentration in the TIC regressions because of the horn-shaped relationship between them. That is, a graph relating the Herfindahl index to the concentration ratio is convex to the origin (Kwoka, 1981; Sleuwaegen and Dehandschutter, 1986). Results, however, with the actual values of these variables are similar to those presented in the section on findings.

Issue and Issuer Characteristics

Since it is more difficult to predict long-term trends than to predict short-term trends, interest rates on bonds tend to rise as the length-to-maturity rises as compensation for the increase in market risk. Also, general obligation bonds, backed by the full faith and credit of the issuing jurisdiction, are considered less risky than revenue bonds. Other bond characteristics that reflect institutional risk and that may interact with market risk include credit ratings of the particular bond; whether the bond carries a call provision; whether it has a put option; whether its coupon rates are fixed or variable; whether the issue is a refinancing; and whether the issue carries credit enhancements, such as bond insurance or a letter of credit, that reduce default risk. Credit enhancements are highly correlated with Standard and Poor's and Moody's credit ratings and cannot be included in the same regressions. Thus, the effects of these variables operate through the credit ratings.

Investment bankers who underwrite a large number of municipal bond issues annually may be more efficient in marketing an issue than other investment bankers. This factor is reflected by the primary underwriter's rank based on total par value of all municipal bonds that it un-

[12] An increase in resources allocated to lowering the TIC raises the fee associated with a given output. But the optimal fee does not rise unless the elasticity of demand falls or the marginal cost of issuing bonds rises [see equation [5]]. Thus, a reduction in the TIC due to an exogenous increase in the marginal revenue from lowering it does not necessarily cause the optimal fee to rise.

[13] Real par value rather than the number of issues is the appropriate output measure because our survey revealed that authorities typically set fees as a percentage of par value. Hence their revenue and income are more closely related to the total par value of their issues than to the number of issues. Concentration measures based on the number of issues are, however, highly correlated with those based on their real par values. Hence, results with the former measures are very similar to those presented in the section on findings.

derwrote as a lead underwriter in the year of issue and by a dichotomous variable that identifies issues in which the primary underwriter is not one of the fifty leading underwriters.

As discussed previously, there is considerable controversy over how the method of sale affects the cost of capital. We hypothesize that, due to decreased competition, negotiated sales and private placements are costlier than bonds issued through competitive bidding processes, all else equal. We do not know the number of bids for competitive issues and therefore include only dichotomous variables for negotiated issues and for private placements. While most studies include the number of bids, they are also generally limited to much smaller numbers of observations than we have.

The number of previous bond deals performed by an issuer measures its experience.[14] One hypothesis is that more experienced agencies have more knowledge concerning the tax–exempt bond market, which may result in lower TICs on their bonds exclusive of fees. Another hypothesis is that fees and TICs inclusive of fees fall with experience if the costs of more experienced agencies are lower than those with less experience. These two hypotheses suggest it may be important to control for experience in estimating the effects of concentration on TICs exclusive of fees. This is because the more concentrated is the market the more likely it is that the number of previous issues is greater. But the experience effects described do not operate through concentration. Put differently, issuers in more concentrated markets have lower costs of production than those in less concentrated markets.

Another hypothesis is that experienced agencies have fewer incentives to invest resources that lower the TIC because they have a well–established clientele. Moreover, fees may rise if more experienced issuers have more monopoly power (have lower price elasticities of demand). In these cases there is less reason to control for experience in estimating the effect of concentration because experience and concentration are proxies for the same causal mechanism. The experience measure is specific to each issuer and is exclusive of the most recent financing (which serves as the observation in the regression analysis). It can be characterized as a lagged variable and was obtained from a backward search of the SDC database. Nursing home and life care issues are included because these reflect experience in issuing tax–exempt bonds in the health care sector.

Finally, it is common in the literature on determinants of interest rates to include the size of the bond issue and its square (for instance, Kidwell and Rogowski, 1983). An argument could be made that issue size is endogenous. This is particularly true for hospitals, which get most of their capital for investment from the bond market. Hospitals should have some idea of the likely TIC before they go to the bond market, and thus may demand more capital the lower is the expected TIC. We believe it is important to raise this point, and that future studies should consider this potential demand–side effect. However, results excluding issue size were not substantively different from those that contained it. Hence, we include this variable in the regressions we discuss in order to capture any premium for the larger issues.

National Characteristics

These are particularly important in measuring market risk. We use the yield

[14] The issuer's history of real par values (total real par value of all previous issues) could also be a measure of experience. The question is whether experience is better measured through the number of deals performed, or the size of the deals. While we present results using the number of deals, the results using issuer's history of real par values were very similar. The same comment applies to the hospital experience measure discussed below.

on a 30–year treasury bond (T–bond rate) in the week of a particular bond issue, as well as the variability of that yield over the eight weeks prior to issue. The Bond Buyer index (a 25–bond yield index for revenue municipal bonds that mature in 30 years) and its variability are alternative measures of market risk. We did not employ this index because typically it contains at least one hospital bond. Thus, a regression of the TIC on the Bond Buyer index approximates one in which the dependent variable is regressed on part of itself. Another way to control for market risk is to employ the difference between the TIC and T–bond rate as the dependent variable. Not surprisingly, in preliminary research we found that this regression had a much lower R–square than a regression with the TIC as the dependent variable and the T–Bond Rate as one of the independent variables (0.45 versus 0.75). But the key coefficients of interest were almost identical.

Changes in Federal tax policy have the potential to impact interest rates on tax–exempt hospital bonds. The Federal income tax rate in the highest tax bracket fell from 50 percent in 1986 to 38.5 percent in 1987 and to 28 percent in 1988 as part of the 1986 tax act. The maximum rate also was cut from 70 percent in 1981 to 50 percent in 1982. Finally, it was raised from 28 percent in 1990 to 31 percent in 1991 and to 36 percent in 1993. Since interest on hospital bonds is not subject to Federal tax, the TIC should rise as the Federal tax rate falls. These effects could be measured by the inclusion of dichotomous indicators for years in which the tax rate changed or by the actual tax rate. Such specifications were not successful because years with low tax rates correspond to years with low inflation and therefore low interest rates. While the T bond rate reflects inflation, the correlation between this variable and time indicators or the Federal tax rate is too high to estimate tax effects. The coefficients of other regressors were, however, very similar in these specifications to those presented in the section on findings.

Our specification does incorporate one extremely important aspect of the 1986 tax act. The act allows only one advance refunding for tax–exempt municipal bonds issued after 1985 and only two advance refundings for bonds issued prior to that year. Thus, it contains incentives to include a call feature in new issues. Grossman et. al. (1993) report that these incentives were realized since the percentage of callable issues increased during the period in which the tax reform legislation was debated and enacted. Since callable issues carry higher TICs, the dichotomous call indicator captures the positive effect of the 1986 tax act on tax–exempt bond yields.[15]

State Characteristics

The most important characteristics we examine are our measures of market concentration discussed in detail above. In addition, we include a measure of the total real par value of all new municipal bond financings in the state of issuer for a given issue year. We do this to control for the sizable pool of within–state capital that may be negatively correlated with concentration and the TIC. Put differently, states with significant financial centers and sizable capital pools may create multiple authorities, but the large capital pool rather than the absence of issuer concentration may be responsible for lower interest rates on hospital bonds. Like the measures of market concentration, total municipal bond financings vary by state by year. In results we do not present here, but which we do discuss below, we used instead the total real par value of all municipal bond financings per capita.

[15] The positive correlation between the call indicator and a dichotomous indicator for years after 1986 and the negative correlation between the call indicator and the Federal tax rate in the highest tax bracket explain in part why the partial effects of tax rate changes cannot be estimated.

We also include the highest state income tax bracket; because hospital bonds are tax exempt, we expect the TIC to be lower as the income tax rate rises. Finally, during part or all of our sample period, six states (New York, New Jersey, Connecticut, Maryland, Massachusetts, and Washington) employed mandatory rate–setting programs (prospective payments to private heath insurance companies) to contain hospital costs. To the extent that these programs reduce payment levels, they increase the risk of default (Sloan, Morrisey, and Valvona, 1987). In highly regulated states, however, there may be a perception of lower default risk because of heavy state involvement in the hospital sector.[16]

County Characteristics

The county unemployment rate and an indicator for whether the beneficiary of the issue (the hospital) is located in a rural county are area–wide indicators of potential default risk.

Hospital Characteristics

The number of previous bond deals in which it was the beneficiary measures the hospital's experience in using the tax–exempt bond market to finance capital investment. As in the case of issuer experience, the effects of this variable on the TIC or the fee are ambiguous on *a priori* grounds. The increased knowledge possessed by hospitals who have made more use of the bond market in the past may be offset by several factors. Less experienced hospitals may have more incentives to search for an issuer that will help secure a lower TIC exclusive of fee or charge a lower fee. Moreover, these hospitals may be more sensitive to fees (may have demand functions with larger price elasticities of demand). If issuers can engage in price discrimination, the fee charged to a less experienced hospital may be lower. The experience measure is exclusive of the most recent financing and was obtained from a backward search of the SDC database.

The ratio of total assets to total liabilities and the operating margin are hospital–based indicators of default risk. The teaching status of a hospital and its membership in a multihospital system also may affect this risk.

Grossman et. al. (1993) have stressed the importance of Medicare and Medicaid reimbursement policies and changes in these policies as determinants of interest rates on hospital bonds. Retrospective, cost–based reimbursement characterized Medicare until the October 1983 introduction and phase–in of the Prospective Payment System (PPS), characterized by a diagnosis related groups (DRG) reimbursement system. This system puts hospitals at complete financial risk for treating Medicare patients. Hospitals that spend less on Medicare patients than the Medicare revenues they receive can keep the difference as profits, while hospitals that spend more are liable for the excess. The impacts of Medicare reimbursement policy are captured by the fraction of inpatient days accounted for by Medicare inpatient days and by the product of that variable, the Medicare PPS profitability margin, and a dichotomous variable for the years that PPS was in effect (1984–93).[17]

[16] Massachusetts and Washington abolished their mandatory–rate setting programs in 1989, and New Jersey abolished its program at the beginning of 1993. These changes are reflected in the dichotomous indicator in the regressions.

[17] The Medicare PPS profitability margin equals the difference between 1984 projected Medicare inpatient revenue from a fully implemented DRG reimbursement system (national costs per case) and revenue based on a given hospital's 1981 Medicare revenue and case mix projected to 1984 divided by 1981 Medicare revenue projected to 1984. Since PPS was phased in, PPS payments are blends of national and hospital–specific costs per case, with the national component increasing over time. Therefore, the variable just defined measures the long–run impact of PPS on the financial position of a given hospital.

Since 1980, state Medicaid systems have been characterized by a downward trend in the number of systems that employ retrospective, cost–based reimbursement. At the same time the number of states using a prospective payment system with a DRG reimbursement methodology or a Medicaid reimbursement system with prospective rate of increase controls or negotiation and fixed contracting increased. The impacts of Medicaid reimbursement policy on the TIC are reflected by the coefficients of the fraction of inpatient days accounted for by Medicaid inpatient days and by interactions between this variable and state– and time–dichotomous indicators of the two reimbursement systems just described.

FINDINGS

Table 3 presents ordinary least squares regression estimates of the determinants of hospital bond cost of capital. The true interest cost, or TIC, is the dependent variable in all regressions. We present four regressions using the same basic regressors except for the measure of market concentration and the credit ratings. For both measures of market concentration, we present results with and without credit ratings. Columns (1) and (2) present estimates of models that include the natural logarithm of the four–largest issuer concentration ratio, and columns (3) and (4) list estimates of models that use the natural logarithm of the Herfindahl index. Larger values of both concentration measures indicate a more concentrated, or centralized, market.[18]

Regressions are estimated with and without the credit ratings in the spirit of the recursive model contained in Grossman, et. al. (1993).[19] In that model the credit ratings are determined by such correlates of default risk as whether the issue is insured, whether it carries a letter of credit, the ratio of assets to liabilities, the operating margin, and the PPS profitability margin. In turn the TIC is determined by the credit ratings and market risk. Grossman, et. al. (1993) stress that a full analysis of the effects of the credit ratings on interest rates must take account of their endogeneity. This does not call for the use of simultaneous equations methods because they specify a model in which yields and the credit ratings are determined in a recursive system with uncorrelated errors. It does mean, however, that causal determinants of the ratings should not be held constant in assessing the effects of the ratings on bond yields. Conversely, inclusion of the ratings may give misleading estimates of the impacts on interest rates of variables that may have important effects on the ratings.

If an issue's credit rating were a perfect correlate of its default risk, there would be no rationale for the inclusion of other correlates of default risk in the same regression. However, the credit rating is determined by employees of the rating agency rather than the bond market. Given this and the many studies in the municipal bond literature beginning with Kessel's (1971) seminal paper that include ratings in bond yield regressions, we assume that the credit ratings are less than perfectly correlated with default risk. Consequently, we estimate regressions with and without the credit ratings. In general, if variable x is a determinant of the bond

[18] The t–ratios in Table 3 are based on standard errors that are not adjusted for heteroskedasticity because robust standard errors (White, 1980) resulted in t–ratios that are almost identical to those in the table. No statement concerning statistical significance in the text would be altered if it was based on robust standard errors.

[19] We use four dichotomous indicators that identify issues rated by Standard and Poor's as AAA, AA+ or AA–, A+ or A–, or below A–. The omitted category pertains to unranked issues. We also include two dichotomous variables that identify issues rated higher by Moody's than by Standard and Poor's or lower by Moody's than by Standard and Poor's.

TABLE 3
DETERMINANTS OF HOSPITAL BOND COST OF CAPITAL: OLS REGRESSION COEFFICIENTS
(DEPENDENT VARIABLE = TRUE INTEREST COST (TIC) INCLUDING FEES CHARGED)
(t – STATISTIC IN PARENTHESES, INTERCEPTS NOT SHOWN, n = 4,576)

Independent Variable	(1)	(2)	(3)	(4)
A. Issue and Issuer Characteristics				
Negotiated	**0.632**	**0.613**	**0.624**	**0.605**
	(7.17)	(7.38)	(7.06)	(7.28)
Private placement	**0.815**	**0.583**	**0.803**	**0.572**
	(5.79)	(4.39)	(5.70)	(4.30)
Call	0.089	0.177	0.090	0.178
	(1.51)	(3.16)	(1.52)	(3.17)
Put	–1.161	–1.363	–1.159	–1.363
	(–6.95)	(–8.63)	(–6.93)	(–8.62)
Fixed	1.623	1.367	1.627	1.370
	(10.13)	(9.06)	(10.14)	(9.07)
Length	0.025	0.026	0.025	0.026
	(9.55)	(10.64)	(9.45)	(10.56)
Pool	–0.013	0.266	–0.008	0.271
	(–0.13)	(2.89)	(–0.09)	(2.94)
Rank	0.006	0.003	0.007	0.003
	(3.84)	(1.99)	(3.88)	(2.01)
No rank	0.345	0.129	0.342	0.127
	(5.98)	(2.34)	(5.93)	(2.29)
General	–0.630	–0.568	–0.622	–0.562
	(–7.52)	(–7.22)	(–7.42)	(–7.13)
Issuer's number of previous issues	–0.002	–0.001	–0.002	–0.001
	(–4.04)	(–2.97)	(–3.68)	(–2.68)
S&P AAA		–1.174		–1.179
		(–20.19)		(–20.27)
S&P AA		–1.062		–1.066
		(–12.76)		(–12.80)
S&P A		–0.582		–0.583
		(–8.85)		(–8.85)
S&P other		0.070		0.065
		(0.89)		(0.83)
Moody high		–0.879		–0.879
		(–13.54)		(–13.52)
Moody low		0.046		0.048
		(1.00)		(1.03)
Refinancing	–0.104	–0.038	–0.108	–0.040
	(–2.40)	(–0.93)	(–2.48)	(–0.99)
Real par	–0.006	–0.003	–0.006	–0.003
	(–4.92)	(–2.38)	(–4.95)	(–2.39)
Real par squared	0.00002	0.00001	0.00002	0.00001
	(4.29)	(2.19)	(4.37)	(2.26)

TABLE 3 (continued)
DETERMINANTS OF HOSPITAL BOND COST OF CAPITAL: OLS REGRESSION COEFFICIENTS
(DEPENDENT VARIABLE = TRUE INTEREST COST (TIC) INCLUDING FEES CHARGED)
(t – STATISTIC IN PARENTHESES, INTERCEPTS NOT SHOWN, n = 4,576)

Independent Variable	(1)	(2)	(3)	(4)
B. National Characteristics				
T bond rate	0.815 (62.43)	0.826 (66.24)	0.815 (62.41)	0.827 (66.21)
Variability	1.667 (8.34)	1.406 (7.47)	1.682 (8.41)	1.417 (7.52)
C. State Characteristics				
State income tax	–3.179 (–5.41)	–3.136 (–5.67)	–2.885 (–4.96)	–2.899 (–5.30)
Mandatory rate setting	–0.050 (–0.69)	0.021 (0.30)	–0.035 (–0.47)	0.032 (0.46)
Concentration ratio	**0.375** **(4.17)**	**0.317** **(3.76)**		
Herfindahl index			**0.084** **(2.82)**	**0.072** **(2.60)**
Total real municipal bond financings	–0.0000005 (–0.10)	0.000002 (0.40)	–0.000005 (–1.17)	–0.000002 (–0.50)
D. County Characteristics				
Unemployment	0.017 (2.17)	0.015 (1.99)	0.017 (2.22)	0.015 (2.03)
Rural	0.045 (0.71)	–0.048 (–0.81)	0.055 (0.88)	–0.039 (–0.66)
E. Hospital Characteristics				
Multi	–0.067 (–1.36)	–0.047 (–1.02)	–0.062 (–1.26)	–0.043 (–0.92)
Teach	–0.243 (–4.01)	–0.166 (–2.92)	–0.249 (–4.10)	–0.171 (–3.00)
Medicare share	0.017 (–0.09)	–0.248 (–1.42)	–0.031 (–0.16)	–0.260 (–1.49)
Medicaid share	0.930 (2.17)	0.822 (2.04)	0.965 (2.25)	0.849 (2.10)
Asset ratio	–0.029 (–2.29)	–0.025 (–2.11)	–0.028 (–2.24)	–0.025 (–2.07)
Medicare share*PPS	–0.969 (–3.91)	–0.700 (–3.00)	–0.958 (–3.86)	–0.690 (–2.96)
Medicaid share*DRG	–1.302 (–2.50)	–1.421 (–2.91)	–1.370 (–2.63)	–1.473 (–3.02)
Medicaid share*other	–1.087 (–2.34)	–0.946 (–2.17)	–1.088 (–2.34)	–0.946 (–2.17)
Operating margin	–1.263 (–3.06)	–0.851 (–2.19)	–1.223 (–2.96)	–0.818 (–2.11)
Hospital's number of previous issues	–0.014 (–2.87)	–0.004 (–0.81)	–0.014 (–2.89)	–0.004 (–0.83)

TABLE 3 (continued)
DETERMINANTS OF HOSPITAL BOND COST OF CAPITAL: OLS REGRESSION COEFFICIENTS
(DEPENDENT VARIABLE = TRUE INTEREST COST (TIC) INCLUDING FEES CHARGED)
(t – STATISTIC IN PARENTHESES, INTERCEPTS NOT SHOWN, n = 4,576)

Independent Variable	(1)	(2)	(3)	(4)
F. Unknowns				
Hospital's number of previous issues unknown	–0.152 (–2.01)	–0.215 (–3.03)	–0.152 (–2.00)	–0.215 (–3.03)
Asset ratio unknown	–0.232 (–1.20)	–0.152 (–0.84)	–0.220 (–1.14)	–0.141 (–0.78)
PPS margin unknown	0.050 (0.72)	0.004 (0.05)	0.047 (0.67)	0.0007 (0.01)
Operating margin unknown	0.273 (3.44)	0.222 (2.99)	0.277 (3.49)	0.225 (3.03)
Other variable unknown	0.107 (0.48)	–0.058 (–0.27)	0.096 (0.43)	–0.068 (–0.32)
R–square	0.719	0.754	0.719	0.753
F–statistic	314.10	322.12	313.18	321.43

yield and the credit rating, the regression that omits the rating provides an upper bound estimate of the absolute value of the effect of x on the yield, while the regression that includes the rating provides a lower bound estimate. In the specific case of underwriter competition, we want to show that estimates of the effect of competitive sales are not due to higher than average credit ratings enjoyed by these sales. In the case of issuer concentration, we want to show that effects are not due to correlations between concentration and requirements that beneficiaries must obtain credit enhancements, such as bond insurance or letters of credit, that are reflected by the ratings. We also note that our model has many more independent variables than other studies that do include the credit ratings.

In discussing the results, we focus on the effects of issuer concentration and on the method of selecting an underwriter. The coefficient on the measures of market concentration is positive and statistically significant in each of the regressions. These results imply that reductions in concentration lower the cost of capital; thus, decentralized states are better off.[20]

There is little evidence that the observed market structure effects result because issuers in less–concentrated states are more likely to require beneficiaries (hospitals) to obtain bond insurance or a letter of credit: The inclusion of the credit ratings, which reflect these credit enhancements, does reduce the value and significance of the concentration measures, but these reductions are very modest. Moreover, as pointed out previously, competition among authorities can take the form of working with the hospital to obtain a more favorable credit rating. If the ratings are held constant, this effect is not fully captured.

There also is little evidence that the concentration effects can be traced to a negative correlation between concentration and the pool of in–state capital to invest in the municipal bond market. This is because the coefficients of total real municipal bond financings are not significant in

[20] Technically, we should probably use the term "deconcentrated" rather than "decentralized," since it is entirely possible for a state to have many state–level issuers, which would thus be picked up by the measures of concentration. However, in practice, deconcentrated states are also decentralized because they have local issuers. Therefore, the term "decentralization" is also appropriate.

the four regressions in Table 3. Negative and significant coefficients emerge when this variable is replaced by per capita real municipal bond financings. In these models, however, the coefficients of the Herfindahl index are larger, and the coefficients of the concentration ratio are only slightly smaller. In the case of the former variable, the coefficient rises from 0.084 to 0.096 in the specification without the credit ratings and from 0.072 to 0.077 in the specification with the credit ratings. In the case of the latter variable, the coefficient falls from 0.375 to 0.360 in the model without the credit ratings and from 0.317 to 0.290 in the model with the ratings. Each of the eight coefficients just mentioned is statistically significant at the 1 percent level on a one–tailed test, which is the relevant test since the alternative hypothesis is that the coefficient is positive.

To gauge the magnitudes of the estimated market structure effects, consider the impact of a one standard deviation reduction in the natural logarithm of the concentration ratio or the Herfindahl index. Based on the regressions without the credit ratings, the TIC would fall by 10 basis points if the concentration ratio fell by one standard deviation and by 7 basis points if the Herfindahl index fell by one standard deviation (1 basis point equals 1/100 of 1 percent).[21] While these reductions may appear small at first, they are larger in absolute value than those associated with a one standard deviation increase in the hospital's overall operating margin or its ratio of assets to liabilities. In addition, market structure is one of the few independent variables over which policymakers have potential control to effect changes. Moreover, the cost of a bond's aggregate debt service during its life of 20 to 30 years to maturity is several times its par value. A reduction in the interest rate of only a few basis points could yield substantial savings over time. For example, a reduction of 10 basis points for all 1,152 health care bonds in 1993 would have yielded $200 million in terms of the present value of interest cost savings.

To further gauge the magnitude of the concentration effects, we consider how much the TIC would fall if each issuer had approximately the same share in real par value. The concentration ratio and the Herfindahl index have means of 0.83 and 0.45, respectively. These are the means of the actual variables rather than the antilogarithms of the means of their logarithms, presented in Table 2. Based on the number of different issuers in the issue year, there were 13 different issuers per state who issued bonds in a typical year in the period from 1980 through 1993. If each issuer had the same share in real par value, the Herfindahl index would equal 0.08, and the concentration ratio would equal 0.31. A two standard deviation reduction in the natural logarithm of the Herfindahl index would produce an actual index of 0.07, and a three standard deviation reduction in the natural logarithm of the concentration ratio would produce an actual ratio of 0.36. Therefore, we use a two standard deviation reduction in the case of the Herfindahl index and a three standard deviation reduction in the case of the concentration ratio.

For the Herfindahl index, the two standard deviation effect amounts to a reduction in the TIC of 14 basis points. For the concentration ratio, the three standard deviation effect amounts to a reduction of 30 basis points. We view an average of the two figures as the best estimate of the impact of inequality in market shares. Thus, departures from equality in market shares raise the TIC by 22 basis points.

[21] All additional computations in the text are based on regressions that exclude the credit ratings.

Negotiated issues and private placements carry higher TICs than competitive issues. The relevant regression coefficients are statistically significant at all conventional levels and rather large in magnitude. A negotiated deal adds approximately 60 basis points to the TIC, regardless of whether the credit ratings are held constant. A private placement adds approximately 80 basis points to the TIC when the ratings are excluded from the regression and adds roughly 60 basis points when they are included. Only 3 percent of the issues are private placements, while 90 percent are negotiated. Therefore, the negotiated differential is the most relevant one. Clearly, there is no evidence that competitive issues enjoy lower TICs than negotiated issues because they have better credit ratings.

Our estimates suggest that the TIC would decline by 54 basis points if the percentage of competitive issues rose from its current value of about 7 percent to 100 percent. The reduction in the TIC that would accompany a much smaller increase in the percentage of competitive issues obviously would be much more modest. Our results suggest that cost savings would be realized by hospitals and third-party payers, including the Federal government, if underwriters were selected by competitive bidding more often. Indeed, the financial stakes are quite high. As noted above, a reduction in the interest rate of only a few basis points could yield substantial savings over time.

In sum, both kinds of competition explored in this study appear to affect the cost of capital, and the current system of hospital bond finance could realize significant cost savings through encouraging and promoting competition. Above, we note that departures from equality in market shares raise the TIC by 22 basis points and that the TIC would fall by 54 basis points if all issues used competitive bidding procedures. To give some perspective and sense of scale, a 76 basis point reduction for all 1,152 health care bonds in 1993 would have yielded $1.52 billion in terms of the present value of interest cost savings. This translates into $1.3 million per issue or 4.7 percent of the total real par value of all bonds in 1993.

In the previous section we suggested interactions among market concentration, issuer experience, and hospital experience that might make it particularly important to control for experience in estimating the effects of concentration. The signs of the coefficients on both issuer's number of previous issues and hospital's number of previous issues are negative and statistically significant in the regressions without the bond ratings. The measure of hospital experience is negative and insignificant in the regressions with the bond ratings. These findings suggest that more experienced issuers have lower costs of production, and more experienced hospitals translate their knowledge about the bond market into lower yields on their issues.

Empirically, issuer and hospital experience are positively correlated, and issuer experience is positively correlated with the concentration ratio and the Herfindahl index. Therefore, the TIC reductions associated with reductions in concentration may overstate the declines that actually would occur because issuers in less concentrated markets appear to have higher costs of production. To examine this issue in more detail, we deleted issuer and hospital experience from the set of regressors. All market structure coefficients fell in absolute value in these specifications, but the reductions were extremely modest.[22] They indicate that of the declines in interest rate associated with reductions in concentration presented above are very reasonable. It is not even clear that active policies to promote competition would

[22] The yield premium associated with a negotiated deal remains the same in these specifications.

impinge on the benefits that accrue to issuer experience. The interest rate reductions associated with these policies should create incentives for hospitals to make more use of the municipal bond market and to have more bonds issued on their behalf. Hence, issuer experience would not necessarily decline.

While these are the results upon which we focus in this study, a number of other results are interesting and merit brief discussion. Although a complete discussion of the hospital characteristics results is beyond the scope of this present paper, almost all variables in the full specification are significant, and most of them have signs consistent with *a priori* expectations. We view this as important and impressive evidence that changes in Medicare and Medicaid reimbursement policies in the 1980s and early 1990s influenced and in some cases lowered hospitals' borrowing costs. An implication of our results is that the use of a prospective payment system at the Federal or the state level selectively reduces the interest rate on hospital debt.

We conclude this section by calling attention to one effect not highlighted by Grossman, et. al. (1993) and to one effect not considered in that study. With regard to the former, a state's income tax rate has a negative and significant effect on the TIC, since the debt is tax exempt. A one standard deviation increase in the tax rate from its mean of 5.5 percent to 9.0 percent lowers the TIC by approximately 10 basis points. One implication of this result is that high–tax states encourage the use of bond markets over other means to finance capital used to provide public goods and services. With regard to the latter, we find the standard impact of issue size and its square. The TIC falls up to an issue size of $150 million in 1982–84 dollars. While the par value of 1 percent of the issues in the sample exceeds this value, it is significantly larger than the issue size of $130 million at three standard deviations above the mean.

DISCUSSION: CONCLUSIONS AND POLICY RECOMMENDATIONS

Our most important findings are that competition among issuers and among underwriters results in lower interest rates on tax–exempt hospital bonds. While there is no previous empirical literature on the effects of issuer concentration, it is useful to compare our findings to the many studies pertaining to the selection of an underwriter by soliciting competitively sealed bids or by negotiating directly with an investment banker (for example, Kessel, 1971; Joehnk and Kidwell, 1979; Sorensen, 1979; Kidwell and Rogowski, 1983; Bland, 1984, 1985; Leonard, 1996; Simonsen and Robbins, 1996). A majority of these studies find either that the interest rate on a competitive issue is smaller than that on a negotiated issue or, in the case of competitive issues, that the interest rate falls as the number of bids rises.

In a qualitative sense, our finding is consistent with this literature. It is not consistent with Leonard's 1996 national study of approximately 2,000 municipal bonds sold in the last half of 1992. He reports no difference in the interest rate on competitive issues compared to negotiated issues. He includes in his regressions, however, the number of bids. This variable has a negative coefficient, which is significant in most of the estimated models. Since it assumes the value of zero in a negotiated deal, Leonard should, but does not, take account of it in computing the interest rate differential between the two types of issues.[23]

[23] Let t be the reoffering yield (the dependent variable in Leonard's analysis), d be a dichotomous indicator of a negotiated issue, and b be logarithm the number of bids received by a competitive issue. With the intercept and other regressors suppressed, Leonard fits a regression of the form:

In a quantitative sense, our differential of 60 basis points between a negotiated and a competitive issue in the hospital bond market is much larger than estimates for other markets. For example, Sorensen (1979) reports that a negotiated deal adds 12 basis points to the interest rate in the case of new financings of corporate bonds. Simonsen and Robbins (1996) report that negotiated deals add about 29 basis points for general obligation bonds in Oregon. In comparing our results to these, one should keep in mind that the percentage of competitive issues in the tax exempt hospital bond market (7 percent in our sample) is much smaller than in the corporate bond market or in the municipal bond market as a whole. For the latter market, approximately 40 percent of all new issues were done on a competitive basis in a typical year in the 1990s. Thus, our results are generalizable within the hospital bond sector and perhaps to other sectors that rely heavily on revenue bonds sold primarily through negotiation. They may not be generalizable to other sectors.

Our results have several implications for public policy at the Federal, state, and local levels. They suggest that state and local governments may want to consider means to encourage the sale of revenue bonds through competitive rather than negotiated sales. Bland (1984, 1985) and Simonsen and Robbins (1996) summarize nicely the caveats to this assertion; nevertheless, it appears that more stands to be gained from encouraging competition among underwriters than in dwelling on the exceptions. Requirements like those implemented by then Governor Florio in New Jersey appear to have potential for significant cost savings. In particular, with the rising use of quasi–public special finance authorities, which are sanctioned by state governments, states have an interest in ensuring that these loosely–regulated entities follow the least costly practices available.

Regarding these quasi–public authorities, states may want to ensure that there is competition to issue hospital bonds, and perhaps other revenue bonds, among authorities and other issuers. At least states should not create and protect monopolies in the market to issue these bonds. They should allow more than one state–level authority to issue hospital bonds and/or allow local authorities to do so. Our results indicate that deconcentration of the hospital bond industry would decrease borrowing costs. Increasing competition between issuers may reduce the need to regulate them more stringently. While it is true that experience on the part of the finance agencies and the beneficiaries may lower the cost of capital (a fact that presumably favors larger and more concentrated issuers), it appears more important to promote competition among issuers and allow market forces to determine how many issuers enter the market, and how they achieve their market share. State governments in concentrated states could achieve some of these same objectives by imposition fee caps. In light, however, of previous failures of price controls in many sectors of the economy, it seems prudent to let the market determine the competitive fee.

It is likely that hospital issuers have become more concerned about the high fees charged by authorities in highly concentrated states as a result of the Federal tax reform legislation enacted in 1986 since the legislation curtailed their arbi-

$$t = \alpha d + \beta(1 - d)b.$$

He argues that the difference in the TIC between negotiated and competitive issues is given by α. The correct estimate is $\alpha - \beta b^*$, where b^* is the mean of the logarithm of the number of bids received by competitive issues. Leonard allows for slope coefficient differences between general obligation bonds and revenue bonds. There are not enough of the latter type of bonds in our sample to consider this issue.

trage profits. Specifically, hospitals must rebate to the Treasury all interest income earned in excess of the yield on tax–exempt bonds which accrue by investing unused proceeds from the tax–exempt market in higher yielding securities. This occurs because there is a lag between project start–up and completion and the bond offering.

The Federal government has several reasons to pay attention to this industry. First, given the tax–deductibility of interest earned on municipal bonds, the Federal government has an interest in ensuring that interest rates are as low as possible to minimize Federal tax expenditures. In addition, the cost of capital in the health care industry affects the cost of providing health care, which is certainly an issue of great salience currently at the Federal level. Therefore, the Federal government should consider policies that would promote competition, both among issuers and among underwriters, in order to realize cost savings in the cost of providing health care and state and local infrastructure. In addition, the use of a prospective payment system at the Federal or the state level selectively reduces the interest rate on hospital debt.

Clearly there is a need for more research in determining the impacts of competition on the cost and interest rates of bonds. More studies using national databases and additional service sectors are needed. We also need to better understand the nature of competition between issuers. Are local authorities sometimes the equivalent of local monopolies? What is the nature of competition between state and local level authorities in those states in which both are operating, and do beneficiaries perceive a choice between local and state level authorities? Nevertheless, it appears wise to continue the calls to promote and foster competition in the municipal bond market, both through competitive rather than negotiated sales and through deconcentrating the state finance agency regimes.

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