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Source: *The Journal of Finance*, Vol. 43, No. 1 (Mar., 1988), pp. 21-40
Published by: Blackwell Publishing for the American Finance Association
Stable URL: http://www.jstor.org/stable/2328320

THE JOURNAL OF FINANCE • VOL. XLIII, NO. 1 • MARCH 1988

Capital Structure, Ownership, and Capital Payment Policy: The Case of Hospitals

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ABSTRACT

This study examines effects of pertinent features of hospital capital payment policies on hospital capital structure decisions in a one-period stochastic, value-maximization model. Separate models are developed for for-profit and not-for-profit hospitals. Hospital debt-to-assets ratios are analyzed empirically using a cross-section of data from the American Hospital Association. Although the effect on capital structure of hospital reliance on cost-based reimbursement cannot be signed theoretically, in both for-profit and not-for-profit cases, a higher cost-based share leads to higher leverage. Factors associated with high bankruptcy risk (e.g., earnings volatility) cause hospitals to take on less debt.

THE HOSPITAL INDUSTRY EXHIBITS two prominent characteristics that have unique implications for its capital structure. First, the majority of hospitals are organized as private not-for-profit (NFP) institutions. Since there is no applicable corporate income tax, any risk of bankruptcy might imply that the NFP hospital would select an all-equity hospital structure. Yet it is a stylized fact that almost all NFP hospitals have debt obligations. At the same time, there exists a sizeable minority of hospitals operated by government or as for-profit organizations. For-profit hospitals are subject to all tax privileges and obligations applicable to for-profit enterprises in other sectors. Thus, the industry provides a laboratory for analysis of the effect of ownership on organizations' capital structures.

A second unique feature of the industry is that almost all hospital revenue is derived from public and private insurers (Waldo et al. [21]). At least until very recently, insurers in this industry paid hospitals on either a retrospective-cost or a retrospective-charge basis.[1] Insurer payment practices, in turn, affect the relative prices of debt and equity. Specifically, Medicare and Medicaid, by far the largest government insurers and about a third of Blue Cross plans, the cost payors, reimburse NFP and public hospitals for "their" share of actual interest and depreciation expense incurred but do not pay such hospitals an explicit

* Boston University, Vanderbilt University, Vanderbilt University, and University of Alabama at Birmingham, respectively. This project was funded by Grant HS05176 from the National Center for Health Services Research and Health Care Technology Assessment. We thank the Hospital Research and Educational Trust for providing access to the data. We are grateful to Robert A. Taggart, Jr., for comments on an earlier draft.

[1] Recently, there has been a growth in prospective payment of hospitals. However, even under such plans, capital payment remains a "cost passthrough."

return on equity.[2] Thus, NFP hospitals can earn a return on equity only from charge insurers and from uninsured patients who pay charges.

On the other hand, the major government insurers not only pay for-profit hospitals for interest and depreciation incurred but also pay them an explicit return on equity that has varied between 1.5 and 1.0 times the interest rate on the Medicare Hospital Insurance Trust Fund. Historically, this rate on the Trust Fund has been close to the rate on ninety-day U.S. Treasury bills (Sloan et al. [18]). During this study's observational period, the applicable multiplier was 1.5. Payment from charge payors does not differ among the organizational forms.

This study has three purposes. The first is to show how the capital payment policy of major insurers affects capital structure. We incorporate pertinent features of the hospital capital system in a one-period stochastic, value-maximization model that typifies the capital structure decision making process of a for-profit hospital. By examining capital reimbursement policy in a standard financial model of capital structure decisions, we can focus on reimbursement before introducing the complication of ownership differences. Second, we modify the model to account for pertinent characteristics of the NFP hospital. Thus, we are able to highlight the differences in capital structure decision making between ownership types, particularly as it relates to cost-based reimbursement. Third, we present an empirical analysis of hospital capital structure, with the hospital as the observation unit, using data from the American Hospital Association's (1983) Annual Hospital Survey. This cross-sectional analysis assesses the role of capital payment practices, bankruptcy risk, and tax policy on hospitals' debt-to-assets ratios.

In the course of our analysis, we address two other issues of general interest. First, does the fixity of cost-based reimbursement stabilize earnings sufficiently to induce additional borrowing, or are there other important effects associated with this reimbursement method? Second, why, in the absence of tax incentives, do NFP organizations hold debt?

The answers to the questions apply in a variety of contexts since some other sectors are partially paid according to retrospective cost principles as well, particularly private firms that derive some revenue from government cost-based contracts. (See, for example, Scherer [14] for a full description of defense contracting.) While the related question of how regulated industries such as utilities choose their capital structure has been previously explored (Taggart [20]; Gellhorn and Pierce [8]; Howe and Rasmussen [9]), the issues involved in the hospital industry are more complex since cost-based revenue is mixed with other revenue and often occurs in a NFP setting as well. Thus, the present work can also be viewed as an extension of the work done on capital structure and rate of return regulation, which should increase understanding of a richer set of industry settings.

I. The Model

The assumptions defining the models applying to both proprietary and NFP hospitals, respectively, are very similar to the set employed by Bradley et al. [3].

[2] Their share is based on the ratio of "their" revenue to total hospital revenue applied to cost (Danzon [6]).

To facilitate comparison of for-profit and NFP cases, assumptions are presented simultaneously as follows:

(A1) Proprietary hospitals solve a one-period problem of value maximization with risk-neutral investors.

(A1a) NFP hospitals maximize the expected excess of revenues over expenses.[3]

(A2) Investors are subject to marginal tax rates on debt and equity income given by t_b and t_s, respectively. Proprietary hospitals are subject to a marginal corporate tax rate given by t_c, sheltered or offset by non-debt tax shields of value ϕ.

(A2a) NFP hospitals are not liable for taxes of any kind

(A3) If the proprietary hospital's cash flow falls below the level of its debt obligations, it is declared bankrupt and must pay costs of bankruptcy equal to a proportionate reduction, k, to the firm's cash flows.

(A3a) Assumption (A3) also applies to NFP hospitals.[4]

(A4) Equity used to finance the investment activity of for-profit hospitals is elastically supplied by shareholders or owners at the risk-free discount rate.

(A4a) NFP hospitals obtain equity funds for investment either (a) from philanthrophy or (b) by deferring the expenditure of cash flow on a utility-related enterprise (i.e., by generating retained earnings).

These assumptions define the basic parameters of the models explored below. Both proprietary and NFP hospitals optimize within an uncertain, one-period framework, concern themselves with net cash flows, and suffer proportionate value losses when debt obligations cannot be met.

A. The Proprietary Case

Given the unique institutional features of the hospital services industry, the for-profit hospital's uncertain excess of revenues over expenses before debt payment in any given period can be written as

$$\tilde{\theta} = \alpha\left(y + r_e\left(1 - \frac{y}{r_b}\right)\right) + (1 - \alpha)\tilde{x}, \tag{1}$$

where

$\tilde{\theta}$ = hospital revenues in excess of costs, a random variable,

α = the proportion of hospital revenue that comes to the hospital on a retrospective, or cost-based, basis, assumed exogenous and nonstochastic,

r_b = the risk-adjusted discount rate applied to promised debt payments,

y = promised end-of-period debt payments,

r_e = the end-of-period return to one dollar of invested equity paid by cost-based payors, and

$\tilde{x}$ = the random excess level of revenues over costs accruing to a hundred percent charged-based hospital.

[3] This assumption is consistent with a wide range of NFP objective functions. The excess of revenues over expenses is merely used to fund the hospital's objectives, such as quantity or quality, beyond their profit-maximizing levels.

[4] In both cases, the costs of bankruptcy result from legal expenses, disruption in provided services, etc. (See Altman [1], Copeland and Weston [5], and others.)

All variables expressed in dollar units are deflated by the dollar value of the hospital's assets, which themselves are normalized to equal one.

According to equation (1), hospital cash flows are a weighted average of the returns from cost-based and all other payors where the weights are nonstochastic and exogenous. (The "all-other" group includes insured patients paying hospital charges or paying a regulated prospective amount, as well as uninsured patients.) Cost-based payors pass through debt and pay an an arbitrary return on equity, r_e, where the "equity base" is calculated as the difference between the value of the hospital's assets (normalized to equal one) and the value of its debt.[5] More important, since the payments of cost payors in excess of costs depend only on cost-based share, it follows that net cash flows from cost-based payors are nonstochastic.

The group labeled "all other payors", on the other hand, returns a random level of revenues in excess of costs. The sources of randomness may owe to volume fluctuations resulting from stochastic levels of community-wide demand, casemix fluctuations that affect costs and, by implication, the margin between costs and revenues,[6] as well as random fluctuations in input prices.

Using equation (1), the proprietary hospital's uncertain, end-of-period return to debt and equity is written as follows:

$$\begin{aligned} x_e &= (\tilde{\theta} - y)(1 - t_c) + \phi t_c && \tilde{\theta} \geq y + \phi \\ &= (\tilde{\theta} - y) && y \leq \tilde{\theta} < y + \phi \\ &= 0 && \tilde{\theta} < y, \end{aligned} \tag{2a}$$

where x_e is the return to equity and

$$\begin{aligned} y_b &= y && \tilde{\theta} \geq y \\ &= \tilde{\theta}(1 - k) && 0 < \tilde{\theta} < y, \end{aligned} \tag{2b}$$

where y_b is the return to debt holders.

Equations (2a) and (2b) incorporate three qualitatively different "states of nature" recognized in the finance literature. (See, for example, Bradley et al. [3].) In one state, net income is sufficient to cover debt obligations, and the residual earnings also exceed the level of income that can be sheltered by non-debt tax shields. In a second state, income exceeds debt obligations, but the residual available to equity holders is fully sheltered by other tax shields. The final state is characterized by bankruptcy.

Equations (2a) and (2b) can also be used to explicitly describe the proprietary hospital's market value as a function of its choice of debt. Recognizing the

[5] In reality, cost-based payors pay interest and depreciation expense as well as a return on equity. In a one-period framework, the analogous payment incorporates full payment of debt principle and interest with no depreciation payment. Note that stochastic fluctuations in financial markets could presumably alter the market value of hospital debt, leading to a recalculation of the hospital's "equity base". In practice, regulations do not make such adjustments and we do not allow for this possibility in our one-period model.

[6] This second consideration is particularly relevant for that portion of admissions that reimburses the hospital a fixed prospective amount prior to admission, such as currently occurs under Medicare's Prospective Payment System. The exact distribution of $\tilde{x}$ depends on the manner in which $(1 - \alpha)$ is decomposed among charge-based, prospective, and uninsured payors. Variation in these payor proportions, however, does not affect the qualitative results.

underlying dependence of $\tilde{\theta}$ on $\tilde{x}$ as described in equation (1), the hospital's value of equity can be written as

$$V_e = \frac{(1-t_s)}{r_0}\left[\int_{\tilde{x}=L^H}^{\infty} ((\tilde{\theta}-y)(1-t_c)+\phi t_c) f(\tilde{x})\, d\tilde{x} + \int_{\tilde{x}=L^M}^{L^H} (\tilde{\theta}-y) f(\tilde{x})\, d\tilde{x}\right], \quad (3a)$$

where

r_0 = the risk-free tax-exempt rate of interest,

$$L^H = \frac{\left(1 - \alpha\left(1 - \frac{r_e}{r_b}\right) y - \alpha r_e + \phi\right)}{(1-\alpha)},$$

corresponding to the limit, $\tilde{\theta} = y + \phi$, and

$$L^M = \frac{y\left(1 - \alpha\left(1 - \frac{r_e}{r_b}\right)\right) - \alpha r_e}{(1-\alpha)}$$

corresponding to the limit, $\tilde{\theta} = y$.

Here, the complicated expressions that define the limits of $\tilde{x}$ capture some of the effects of cost-based insurer dependence on the relative likelihood of bankruptcy and other states of nature. Specifically, the average revenues earned on charge-based payors need not equal the level of income corresponding to the transition from one state to another since $\tilde{\theta}$ is formed as a weighted average of both charge-based and cost-based revenues. For example, if cost-based payors pay a "stingy" level of reimbursement, then $\tilde{x}$ may actually exceed promised debt payments, y, at the point of bankruptcy. Thus, one effect of cost-based payor reliance is to change the relative likelihood of different states of nature.

Next, the market value of hospital debt can be written as

$$V_b = \frac{(1-t_b)}{r_0}\left[\int_{\tilde{x}=L^M}^{\infty} y f(\tilde{x})\, d\tilde{x} + \int_{L^L}^{L^M} (1-k)\tilde{\theta} f(\tilde{x})\, d\tilde{x}\right], \quad (3b)$$

where

$$L^L = \frac{-\alpha\left(y\left(1 - \frac{r_e}{r_b}\right) + r_e\right)}{(1-\alpha)}$$

corresponding to the limit, $\tilde{\theta} = 0$.

Combining equations (3a) and (3b), the market value of the firm can be written as

$$\begin{aligned} V &= V_e + V_b \\ &= \frac{1}{r_0}\left[\int_{L^L}^{L^M} (1-t_b)(1-k)\tilde{\theta} f(\tilde{x})\, d\tilde{x}\right. \\ &\quad + \int_{L^M}^{L^H} ((1-t_s)(\tilde{\theta}-y) + (1-t_b)y) f(\tilde{x})\, d\tilde{x} \\ &\quad \left. + \int_{L^H}^{\infty} ((\tilde{\theta}-y)(1-t_s)(1-t_c) + \phi(1-t_s)t_c + y(1-t_b)) f(\tilde{x})\, d\tilde{x}\right]. \quad (3c) \end{aligned}$$

Equation (3c) describes overall firm value in each of the three qualitative states of nature. At this point, the effects of the unique institutional features of third-party payment on the hospital's choice of leverage are not readily apparent, presumably "buried" in the limits as discussed above. The hospital's optimal choice of debt is implicitly given by the first-order condition,

$$\begin{aligned} V_y = & -L_y^M(1 - t_b)kf(L^M)y^* + (F(L^M) - F(L^L))(1 - k)(1 - t_b)\tilde{\theta}_y \\ & + (F(L^H) - F(L^M))((1 - t_b) - (1 - t_s)(1 - \tilde{\theta}_y)) \\ & + (1 - F(L^H))((1 - t_b) - (1 - t_s)(1 - t_c)(1 - \tilde{\theta}_y)) \\ = & \ 0, \end{aligned} \tag{4}$$

where

y^* = the optimal level of promised debt,

$F(\cdot)$ = the cumulative distribution function of $\tilde{x}$,

$$L_y^M = \frac{\left(1 - \alpha\left(1 - \frac{r_e}{r_b}(1 - \varepsilon)\right)\right)}{(1 - \alpha)},$$

the partial of L^M with respect to y, and

$$\tilde{\theta}_y = \alpha\left(1 - \frac{r_e}{r_b}(1 - \varepsilon)\right),$$

where ε = the elasticity of r_b with respect to y.

Equation (4) incorporates the basic elements that most financial economists believe determine the point of optimal leverage in a world of bankruptcy and taxes. In particular, the relative tax advantage of debt versus equity as defined by the relationship between $(1 - t_s)(1 - t_c)$ and $(1 - t_b)$ (Miller [11]), the likelihood that the hospital finds itself in states of nature where its non-debt tax shields are adequate to shelter its income (DeAngelo and Masulis [7]), and the contribution of debt to marginal bankruptcy risk (Kraus and Litzenberger [10]) are all crucial and can be found in equation (4).

From both policy and theoretical perspectives, however, the more relevant question is how the existence and extent of cost-based payment affect the hospital's choice of leverage. The effect of a change in the cost-based share on the hospital's debt-to-assets ratio (y) is given by

$$\frac{dy}{d\alpha} = -\frac{V_{y\alpha}}{V_{yy}}. \tag{5}$$

Since V_{yy} must be negative by the second-order condition for a maximum, the sign of $(dy/d\alpha)$ depends only on the sign of $V_{y\alpha}$. If $V_{y\alpha}$ is positive, $(dy/d\alpha)$ is positive; if $V_{y\alpha}$ is negative, $(dy/d\alpha)$ is negative.

While intuition suggests that the institutional features of such payment should stabilize earnings (reduced variance) and thus increase optimal leverage ($V_{y\alpha} >$ 0), careful analysis of this first-order condition shows this to be only part of the story. In fact, the effects of cost-based average (α) on optimal leverage are ambiguous and work in three distinct ways. (See Appendix A.)

(1) *Effects of cost-based payment on the marginal risk of bankruptcy:*

Increases in α affect the marginal risk of bankruptcy in two offsetting ways. First, increased α reduces the threshold of cash flow where bankruptcy occurs, i.e., L_α^M is negative. This drop in threshold encourages the hospital to issue more debt. However, higher α also raises the responsiveness of the bankruptcy threshold to changes in leverage ($L_{y\alpha}^M > 0$). With higher α, any increased borrowing more rapidly increases the number of states of nature where bankruptcy occurs. Intuitively, this is because the fixity of cost-based payment means that the marginal borrowing must be concentrated on a smaller group of charged-based payors.

(2) *Effects of cost-based payment on the value of debt as a tax deduction:*

Cost-based payment affects the value of debt as a tax deduction in two ways. First, by lowering the threshold value of $\tilde{x}$ corresponding to bankruptcy, greater reliance on cost-based payment extends the lower limit on the second regime in which non-debt tax shields are not fully utilized and reduces the number of bankrupt states. Since, in the second regime, debt has positive net tax value only if $t_s > t_b$ (only if there is a personal income tax advantage to holding debt—there is no corporate tax advantage), the net effect of this term on borrowing will be positive only under that condition.[7] Second, a change in the cost-based share has an ambiguous effect on the relative likelihood of the third state of nature in which all non-debt tax shields are utilized and debt has a greater marginal value, i.e., L_α^H is ambiguous. This ambiguity arises because cost-based payment affects hospital income at the transition point between the second and third regimes. If the cost-based share increases hospital income at the transition point, then the third regime becomes more likely and the incentive for debt financing will increase. However, the net effect of cost-based payment on the tax value of debt, as with the bankruptcy issue, is ambiguous.

(3) *Effects of cost-based payment on the real income value of debt:*

Finally, note that equation (4) also incorporates a term, $\tilde{\theta}_y$, that measures a type of income effect from borrowing associated with third-party payor dependence. Changes in α also affect this cash flow associated with marginal borrowing. However, once again the direction of influence cannot be determined conceptually. Increased α will tend to raise optimal borrowing through this avenue if (a) the end-of-period promised return by the cost payor on one dollar of invested equity (r_e) is less than the risk-adjusted discount rate applied to promised debt payments (r_b) (in such cases, cost-based payors offer an obvious incentive to take on debt), (b) the elasticity relating changes in r_b to changes in indebtedness (ε) is large, and (c) the probability of the regime in which the marginal dollar of debt enjoys a corporate tax advantage exceeds the probability of the regime in which the hospital is not bankrupt but cannot use the corporate tax advantage of debt at the margin, which in turn exceeds the probability of bankruptcy, i.e., $F(L^H) \geq F(L^M) \geq F(L^L)$. If any of the above conditions are violated, an increased cost-

[7] While it is generally assumed in the literature that $t_b > t_s$, the widespread availability of tax-exempt debt in this industry calls that assumption into question.

based payor share could have a negative impact on cash flow and hence decrease borrowing.

The principle lesson to be learned here, then, is that cost-based payment does not necessarily promote a debt bias in the proprietary case since the effects of α on both bankruptcy risk and the tax value of borrowing are (surprisingly) ambiguous.

B. The NFP Case

While the assumptions underlying the borrowing behavior of profit-seeking and NFP organizations are similar, there are two noteworthy differences. First, NFP hospitals have no tax liabilities. Thus, the marginal benefit of borrowing cannot be defined in these terms.

Second, the decision to take on additional debt by NFPs does *not* remove equity from the hospital and place it in the hands of shareholders; instead, equity must remain in the hospital since it has no shareholders to pay. This immediately raises two important questions. First, what happens to marginal equity when it is replaced by debt? Second, and perhaps more important, what is the associated opportunity cost of equity finance?

In principle, there are two sets of answers to these questions. Equity *not* used to underwrite the hospital's physical assets can be expensed or alternatively can be invested in financial assets. Which of these possibilities actually holds, in turn, partly depends on the original source of the equity finance. If, for example, NFP equity is generated by postponing expenditures, then the opportunity cost of equity is defined by the utility that hospital administrators (in the absence of any other residual claimant) enjoy from spending at the margin on variable inputs, salaries, or other objectives. Conversely, if the source of equity is philanthropy or a government grant and it is difficult if not illegal to spend such funds directly on items other than capital, then the opportunity cost of such equity is the foregone interest that can be earned on its short-term investment in financial assets.

We restrict our attention to the case in which equity not invested in physical assets is immediately expensed on some other hospital objective. This approach recognizes that, in recent years, philanthrophy in this sector has declined to a small percentage of investment funds (Cohodes and Kinkead [4]) so that hospital investment is financed, on the equity side, by deferring purchase of other inputs, i.e., from retained earnings.[8]

In this case, there are two reasons for hospitals to leverage their physical assets. First, the NFP hospital may choose to issue positive levels of debt, provided that the discount rate applied to utility (the implicit opportunity cost of equity) exceeds the interest rate on debt.

A second incentive arises from the rather peculiar way that cost-based payors pay the NFP hospital's equity expenses. As a rule, no return on equity is allowed, thus offering an apparent incentive to NFP hospitals to take on debt. In principle,

[8] This is commonly referred to as "retained earnings", although our discussion makes clear that perhaps a better term would be "deferred consumption". A hospital model incorporating philanthropy is presented elsewhere (Sloan et al. [17]).

this bias in favor of debt is counteracted by the cost-based payor rule, applicable to all hospital ownership types, which requires that any interest earned on financial assets must be deducted from the hospital's allowable capital expenses. Thus, for example, if the hospital takes on a great deal of debt in order to "free up" its equity to earn a greater return through a financial investment, cost-based payors respond by *deducting* the interest income earned by the "freed up" equity from cost-based payor revenues. This, in turn, should provide a disincentive for such hospitals to acquire debt for reasons of financial arbitrage.

This "safeguard" against excessive leverage fails when the hospital draws its equity by delaying other expenditures (retained earnings). In this case, "freed up" equity earns an implicit rate of return that exceeds that allowed by cost-based payors. However, this return is measured in the added utility the NFP hospital receives by receiving utility from its expenditures one period earlier. This "shadow" rate of return is *not* deducted from the cost-based payors' capital payments, so the incentive to take on debt finance remains on the cost-based side of the ledger. Such payors are willing to cover the cost of additional nurses and laboratory supplies or higher wages, for example.

This argument can be demonstrated formally, as follows. The analog to proprietary net revenues in the NFP case can be written as

$$\tilde{\theta}_{NFP} = \alpha\left[1 + y\left(1 - \frac{1}{r_b}\right)\right] + (1 - \alpha)\tilde{x} + \delta\left(\frac{y}{r_b}\right) - y, \tag{6}$$

where δ = the time rate of discount applied to the flow of hospital utility, $\tilde{\theta}_{NFP}$ is the NFP counterpart of $\tilde{\theta}$ net of debt repayment, and other symbols are defined as before.

According to equation (6), NFP hospitals are reimbursed by cost-based payors according to a formula that is very similar to the proprietary case. That is, promised debt payments are fully "passed through", and there is a return *of* equity costs (depreciation) although not a return on NFP equity ($r_e = 0$). There is no explicit deduction on the cost-based side for interest income earned on equity "freed up" by marginal debt financing. This acknowledges that all equity released by marginal additions of debt is immediately expensed and earns no interest income.[9]

On the other hand, there *is* a shadow rate of return associated with equity freed for the immediate consumption of variable inputs. This results from administrator preferences for enjoying flows of utility resulting from expenditures now, as opposed to one period hence. Thus, marginal borrowing is associated with a utility-equivalent additional cash flow given by $(y\delta/r_b)$.[10]

To write an explicit formulation for the NFP hospital's uncertain returns, a

[9] Of course, an approach that emphasizes the role of retained earnings immediately suggests a dynamic approach to the problem. This method is not employed here to keep the exposition as clear as possible. No essential characeristics of the steady-state solution are compromised in proceeding in a one-period mode.

[10] Of course, denominating the time value of immediate input consumption in dollars, as is done here, is valid under the assumption that the marginal utility of a dollar is equal across periods. (This invokes the steady-state assumption.)

bankruptcy point must be defined. Since equity not invested in the hospital's physical assets is *not* available to pay debt service, the bankruptcy point is defined by

$$\alpha\left(1 + y\left(1 - \frac{1}{r_b}\right)\right) + (1 + \alpha)\tilde{x} = y. \tag{7}$$

This can be rewritten as

$$\tilde{x} = y - \frac{\alpha}{(1 - \alpha)}\left(1 - \frac{y}{r_b}\right) = \hat{x}. \tag{7a}$$

Using (7a), an expression for the NFP hospital's expected level of discretionary profit can be written as

$$\mathrm{E}(\tilde{\theta}_{NFP}) = \int_{\tilde{x}=\hat{x}}^{\infty}\left(\alpha\left(1 + y\left(1 - \frac{1}{r_b}\right)\right) + (1 - \alpha)\tilde{x} + \delta\left(\frac{y}{r_b}\right) - y\right)f(\tilde{x})\,d\tilde{x}. \tag{8}$$

Maximizing (8) with respect to y yields an implicit expression for optimal debt holdings as

$$\alpha\left(1 - \frac{1}{r_b}(1 - \varepsilon)\right) + \frac{\delta}{r_b}(1 - \varepsilon) - 1 = 0. \tag{9}$$

A sufficient condition for the first-order condition in (9) to be satisfied internally is $\varepsilon < 1$. A well-defined internal solution to the problem exists in this case since, at sufficiently high levels of leverage, r_b will rise high enough to reduce the marginal net value of borrowing to zero.

Equation (9) suggests two reasons that NFP hospitals may issue debt. On the cost-based side, a bias is created by the fact that the utility-related earnings obtained from immediate consumption of "freed up" equity are not deducted from the cost-based payment. Coupled with the fact that cost-based payors do not pay a return on equity, a bias is created in favor of debt financing as explained above. This is captured in the term, $\alpha(1 - (1/r_b)(1 - \varepsilon))$. Second, large δ relative to r_b creates an incentive to substitute debt for equity financing since the opportunity cost of equity, δ, exceeds the opportunity cost of debt.

As in the proprietary case, we consider how the NFP hospital's degree of cost-based payor reliance affects its borrowing decision. While intuition suggests that cost-based reliance should reduce bankruptcy risk and stimulate borrowing, the sign of this effect, as in the proprietary case, is ambiguous.

On the one hand, there are two ways in which cost-based payor reliance stimulates borrowing. First, increased cost-based reliance magnifies the bias that cost-based payors offer in favor of debt financing, as explained above. Second, and more implicitly, cost-based payor reliance reduces the risk associated with debt finance as reflected in the risk-adjusted discount rate, r_b. This is because cost-based payor reliance reduces the likelihood of bankruptcy and increases income in all bankrupt states. Both of these effects stimulate hospital borrowing, ceteris paribus.

However, cost-based reliance also affects the elasticity of r_b with respect to y in an ambiguous manner, thus making the overall cross-partial of (9) with respect to α ambiguous. Finally, if one introduces the plausible assumption that the partial derivative of ε with respect to α is less than ε, it can be easily shown that the effect of α on borrowing becomes unambiguous, with cost-based payor reliance inducing greater borrowing.[11] Thus, unlike the proprietary case, a simple plausible restriction leads us to conclude that cost-based payor reliance increases borrowing in the NFP case.

C. *Implications for Empirical Analysis*

Our conceptual analysis offers the following major implications for empirical analysis of hospital capital structure.

1. Under plausible assumptions, increased cost-based market share unambiguously leads NFP hospitals to issue more debt. Because of more complex offsetting effects, it is more difficult to determine the effect of any increased cost-based share on for-profit hospital capital structure.

2. The underlying models for the two hospital ownership types are similar. Both maximize cash flow, albeit for different purposes—one to serve some nonpecuniary objective, such as providing a higher level of service than the profit-maximizing level, and the other to distribute equity income to owners. Bankruptcy risk is a consideration in both. The cost-based share enters in both, but the underlying mechanisms differ since institutional differences lead to different motivations for holding debt by ownership. Thus, allowing for differences in the underlying parameters, it is appropriate to assess NFP capital structure decisions with the same type of empirical model used to assess the for-profit ones.

II. Data and Empirical Specification

A. *Data*

The principal data source is the American Hospital Association's (AHA) 1983 Annual Survey of Hospitals, which permits analysis at the level of the individual hospital. In its Annual Survey, the AHA solicits responses from all hospitals in the United States. We limit the sample to independent, nonfederal short-term general hospitals. By "independent," we mean hospitals not affiliated with chains. Capital structure of chain hospitals should be examined at the corporate level rather than for individual hospitals; because of missing values for individual hospital members of chains, our data do not permit us to develop estimates for entire chains. To be included in our sample, there also had to be complete responses from the hospital to questions related to our dependent and independent variables. We eliminate all government hospitals other than those operated by special hospital district authorities. As single-purpose districts, they have objectives and constraints analogous to private nonprofit hospitals. Their admission practices and amenity levels also tend to be similar. Other government hospitals, such as state or county hospitals, may be guided by different objectives and constraints from those considered by our NFP model. Therefore, such hospitals are excluded from our sample.

[11] See the Appendix for a formal proof. The restriction $\varepsilon_\alpha < \varepsilon$ is plausible under a wide range of distributions including normality, for example. Details are available from the authors.

We are left with 1,407 hospitals, of which eighty-five percent are private nonprofit, three percent (forty-two hospitals) are proprietary, and twelve percent are government district hospitals. To compute volatility of each hospital's cash flow, we use hospital-specific cash flow data from the AHA Annual Surveys for 1978 through 1983. All other variables are for 1983.

B. Empirical Specification

The dependent variable is the hospital's debt-to-assets ratio, measured in book value. Since almost none of the hospitals in our sample are publicly traded, there is no way to obtain values for the market value of assets. Past studies in this area have also worked with book value debt or asset information or both. "Debt" includes only long-term debt.[12] Assets include net (of depreciation) plant assets and financial assets, including the hospital's restricted fund balance.

The variable *ALPHA* is the fraction of hospital gross patient revenue (charges) from cost-based payors. To determine whether *ALPHA* effects differ by ownership, we include an interaction variable *ALPHA*IO*, where *IO* is one if the hospital is a for-profit one. We do not include an *ALPHA*-hospital district interaction term because, on institutional grounds, district hospitals are quite similar to the NFPs. We do allow for a different intercept for district hospitals (*DISTRICT*) and for *IO* hospitals.

We include several indicators of bankruptcy risk. The first is the observed volatility of the hospital's cash flow over a six-year period (*VOLATILITY*), defined as the standard deviation of the first difference in annual earnings before interest, depreciation, and taxes (taxes for for-profit hospitals only) divided by the mean value of the hospital's assets over the same period.

Data on prior earnings were missing for several hospitals. To avoid losing a substantial part of the sample, we include a binary variable that is one when the variable *VOLATILITY* cannot be computed (*VOLA*MISSING*) in one regression. In the other regression, *VOLA*MISSING* and the 333 observations are excluded.

In practice, *VOLATILITY* may not capture differences in ex ante bankruptcy risk. Hospital decision makers may have considered some possible adverse outcomes when they made their capital structure decisions (e.g., an aggressive pricing strategy by a competitor) that did not occur during the historical period for which *VOLATILITY* is defined. The other bankruptcy risk measures capture dimensions of risk not captured by *VOLATILITY*.

The second bankruptcy risk measure is *MONOPOLY*, which is one if the hospital is the only hospital in the county. Monopoly status, though fairly frequent (fifteen percent of our sample hospitals), only occurs in nonmetropolitan areas. In most such cases, the size of the local population can support only one hospital. Such natural monopolies are isolated from the various types of strategic behavior and outcomes that characterize competitive markets.[13] To be sure that

[12] Results using more inclusive measures of debt are very similar to those presented here.

[13] In Spence [19], monopoly power is hypothesized to give the firm latitude in setting its capital structure. Thus, the author tests whether monopoly status is related to the *deviation* of actual capital structure from its optimal value. His empirical results are not very promising.

MONOPOLY measures the protective effect of monopoly status from earnings variability rather than on omitted city-size effect, we include a variable *SMSA*, which is one if the hospital is located in a Standard Metropolitan Statistical Area (SMSA).

Third, hospitals reliant on a high share of patients with delinquent payment records (for one, because they lack health insurance) are subject to greater bankruptcy risk in severe recessions. This factor is measured by *UNCOMP*, the sum of bad debt and charity care denominated in charges divided by the hospital's gross patient revenue. Bond rating authorities use *UNCOMP*, among other indicators, in determining hospital bond ratings (Booz, Allen, and Hamilton [2]).

Fourth, hospitals with access to nonpatient revenue—public or private donations, income from nonhealth sources (parking lots, real estate, etc.), or both—should be subject to less bankruptcy risk. This is measured by *OTHREV*, hospital nonpatient revenue as a fraction of total revenue (net patient revenue plus nonpatient revenue).

Smaller hospitals are subject to greater bankruptcy risk; their higher failure rate has been documented (Mullner et al. [12]). We measure hospital size with a set of binary variables: less than one hundred beds, *BED*1; one hundred to 249 beds, *BED*2; 250 to 399 beds, *BED*3; and hospitals in the 400-beds-and-over category are in the reference group.[14] Because of their affiliation with a medical school, teaching hospitals may also be subject to less bankruptcy risk. Unfortunately, empirical evidence on failure rates of such hospitals is unavailable. In our study, *TEACH* equals one if the hospital is affiliated with a medical school. None of the teaching hospitals are organized on a for-profit basis during our period of study.

To distinguish regime 2 (in which income of the for-profit hospital exceeds its debt obligations but the residual available to shareholders is fully sheltered by non-debt tax shields) from regime 3 (in which net income is sufficient to cover debt obligations and the residual earnings also exceed the income levels that are sheltered by non-debt tax shields), we include a variable *TAX-SHIELD*. The variable is the sum of hospital depreciation and investment tax credit divided by profit minus the sum of interest and depreciation. If the quotient exceeds one, we set *TAX-SHIELD* equal to one; otherwise, *TAX-SHIELD* is a fraction. The denominator is positive for all for-profit hospitals in the sample. Data on the investment tax credit (ITC) were not available from the hospital survey. The ITC was calculated as ten percent of capital expenditures for fixed equipment and buildings and 6.7 percent of capital expenditures for major movable equipment in the current and previous years. One third (fourteen) of the for-profit hospitals had non-debt tax shields in excess of profit less interest and depreciation.

The ratio of the hospital's value of plant and equipment to total assets (*PLANT*) is included to determine whether debt is used more readily if there are durable assets to collateralize the debt; this point is not covered by our models. However, the underlying conceptual rationale has been developed by Scott [15],

[14] Using a model similar to the one we use for for-profit hospitals, Scott [15] obtains the theoretical result that optimal debt varies positively with firm size.

and the notion has some support from previous studies of capital structure in other industries (Spence [19]; review of published and unpublished studies in Copeland and Weston [5]; Myers [13]). Because of the transactions costs of acquiring debt, and to borrow against future cash flow, hospitals, and firms more generally, tend to have debt-to-assets ratios above their targets in the years immediately following a major capital expenditure, such as purchase of a new building. We measure the age of the hospital's tangible assets as cumulative depreciation on plant and equipment divided by annual depreciation payments (*AGE*). Calculated in this manner, the mean "age" of hospitals in our sample is eight years.

Table I shows means, standard deviations, and brief definitions of the variables just described.

III. Empirical Results

Two capital regressions are presented in Table II. The first is based on 1,407 hospitals with *VOLA*MISSING* included as an explanatory variable. The second excludes the 333 hospitals for which there are insufficient data to compute *VOLATILITY*. The R^2s are 0.24 in both cases, and a number of coefficients attain significance at the ten percent level or better (two-tailed test).

The cost-based share (*ALPHA*) clearly has a positive impact on the hospital's debt-to-assets ratio, with an associated elasticity at the observational mean of 0.2. This is true for NFP hospitals for which the model under plausible assumptions yields an unambiguous positive prediction and also for for-profit hospitals for which the predicted effect of *ALPHA* was ambiguous. In fact, judging from the coefficients on *ALPHA*IO*, *ALPHA* has a higher impact on for-profit leverage. Holding other variables constant, ownership has no statistically significant influence on hospital capital structure.

Some parameter estimates on explanatory variables representing hospital bankruptcy risk have the anticipated signs. Hospitals with a more volatile earnings history have lower debt-to-assets ratios. The coefficient on *VOLATILITY* is rather insensitive to the inclusion or exclusion of the 333 hospitals for which we have adequate data on prior earnings. Judging from the coefficients, the 333 hospitals have higher-than-average debt-to-assets ratios. Although the coefficients on *MONOPOLY* are not statistically significant at conventional levels, their positive signs (and near significance) are consistent with the view that such hospitals face less bankruptcy risk. Metropolitan hospitals (*SMSA*) tend to take on more debt, ceteris paribus.

The parameter estimates on the other bankruptcy risk variables are either insignificant or have unanticipated signs. Holding other factors constant, the amount of bad debt and charity care (*UNCOMP*) has no statistically significant effect on hospital leverage. An earlier study based on a different equation specification (Sloan et al. [16]) found that *UNCOMP* has a negative effect on indebtedness of hospitals. Nonpatient revenue has an unanticipated negative influence on hospital leverage in Table II. Bed size and teaching status show no systematic relationship to hospital borrowing.

Table I

Variable Definitions, Means, and Standard Deviations

Explanatory Variables	Definitions	Mean	Standard Deviation
Dependent:			
*DA*1	Debt-to-assets ratio	0.301	0.212
Explanatory:			
ALPHA	Share of gross patient revenue from cost-based payors	0.623	0.155
IO	Dummy variable; value is one when investor-owned, zero otherwise	0.030	0.170
DISTRICT	Dummy variable; value is one when the hospital is government district hospital, zero otherwise	0.121	0.326
*ALPHA***IO*	Interaction of *ALPHA* and *IO*	0.018	0.107
VOLATILITY	Standard deviation of the first difference in annual earnings; change in profit before interest, depreciation, and taxes divided by mean assets of hospital for same period	0.034	0.045
*VOLA***MISSING*	Dummy variable; value is one when *VOLATILITY* is missing, zero otherwise; when *VOLA***MISSING* is one, *VOLATILITY* is zero	0.244	0.429
MONOPOLY	Dummy variable; value is one if there is only one hospital in the county, zero otherwise	0.145	0.352
UNCOMP	(Bad debt + charity denominated in charges)/gross patient revenue	0.041	0.034
OTHREV	Non-patient revenue/(net patient revenue + non-patient revenue)	0.022	0.022
*BED*1	Dummy variable; value is one if the hospital has less than one hundred beds, zero otherwise	0.286	0.452
*BED*2	Dummy variable; value is one if the hospital has beds ≥100 but ≤249, zero otherwise	0.381	0.486
*BED*3	Dummy variable; value is one if the hospital has beds ≥250 but ≤399, zero otherwise	0.180	0.384
TEACH	Dummy variable; value is one if the hospital is affiliated with a medical school, zero otherwise	0.203	0.402
TAX-SHIELD	(Depreciation + investment tax credit)/profit before interest and depreciation; for *IO* hospitals, zero otherwise	0.010	0.074
PLANT	Net plant assets/total assets	0.526	0.132
AGE	Age of the hospital in years measured as cumulative depreciation/annual depreciation	7.865	3.288
SMSA	Dummy variable; value is one if the hospital is located in a Standard Metropolitan Statistical Area, zero otherwise	0.634	0.482

Table II

Capital Structure Regressions[a]

Explanatory Variables	Reg. 1	Reg. 2
ALPHA	0.1129[b]	0.1104[b]
	(0.0359)	(0.0397)
IO	−0.0215	0.0111
	(0.1178)	(0.1600)
DISTRICT	0.0067	−0.0138
	(0.0166)	(0.0186)
*ALPHA*IO*	0.2289	0.4593[c]
	(0.1703)	(0.2293)
VOLATILITY	−0.2181[d]	−0.2358[c]
	(0.1239)	(0.1181)
*VOLA*MISSING*	0.0127	—
	(0.0132)	(—)
MONOPOLY	0.0187	0.0253
	(0.0166)	(0.0184)
UNCOMP	−0.1198	0.0580
	(0.1575)	(0.2039)
OTHREV	−0.6731[b]	−0.8886[b]
	0.2405)	(0.2933)
*BED*1	−0.0092	0.0259
	(0.0220)	(0.0241)
*BED*2	0.0238	0.0529[b]
	(0.0196)	(0.0211)
*BED*3	0.0193	0.0340[d]
	(0.0188)	(0.0200)
TEACH	−0.0076	0.0145
	(0.0170)	(0.0181)
TAX-SHIELD	−0.1822[d]	−0.7062[b]
	(0.1087)	(0.2453)
PLANT	0.2965[b]	0.2141[b]
	(0.0405)	(0.0471)
AGE	−0.0217[b]	−0.0257[b]
	(0.0017)	(0.0020)
SMSA	0.0464[b]	0.0416[b]
	(0.0138)	(0.0152)
INTERCEPT	0.2257[b]	0.2771[b]
	(0.0441)	(0.0511)
R^2	0.24	0.24
F	25.50[b]	20.94[b]
Sample size	1,407	1,064

[a] Standard deviations are shown in parentheses.

[b] Statistically significant at the one percent level, two-tailed t-test.

[c] Statistically significant at the five percent level, two-tailed t-test.

[d] Statistically significant at the ten percent level, two-tailed t-test.

The model predicts that non-debt tax shields, which are substitutes for tax benefits obtained from debt financing, should be negatively related to firms' debt-to-assets ratios. The tax shield (*TAX-SHIELD*) coefficient is statistically significant with the anticipated negative sign at the ten percent level when all sample hospitals are included; with the smaller sample, the coefficient is much larger in absolute value and is significant at the one percent level. Because of its large sample size, the result from the first regression deserves more credence. Even though the underlying theory is strong, the supporting empirical evidence from previous studies of capital structure is weak (Bradley et al. [3]; review by DeAngelo and Masulis [7]).

Hospitals with a higher fraction of total assets in tangible form take on more debt, as previous work suggests. Hospitals with newer plants, as expected, are more leveraged. Parameters on both variables are statistically significant at better than the one percent level.

Overall, then, the results are very satisfying and confirm a priori expectations where such expectations were held. Of special note is the fact that the coefficients on both earnings variability and non-debt tax shields assume the anticipated sign at statistically significant levels. This is particularly striking given the difficulty that other empirical studies of capital structure have had in confirming the anticipated effects of these variables.

IV. Discussion and Conclusions

This study developed two major themes. First, we examined the effect of third-party payment practices in the hospital sector on leverage. We did this first by investigating the influence of a change in the hospital's cost-based share on capital structure decisions of for-profit hospitals. Second, we were interested in the influence of ownership on capital structure, in particular the interaction of the effect of the cost-based share and ownership on leverage. Third, this study investigated the role of variables used in past research on capital structure, such as volatility of earnings and non-debt tax shields. Since empirical research on capital structure is still in its infancy (see, for example, Myers [13]), these results, such as on earnings volatility and tax shields, are of general interest.

Although we identify offsetting effects of cost-based share on for-profit hospitals' optimal capital structure, the message from our empirical work for both for-profit and NFP hospitals is clear—namely, that hospitals highly dependent on revenue from cost-based payors take on more debt. From a policy standpoint, this result is bad news for hospitals because cost-based reimbursement is rapidly disappearing and many hospitals will be faced with debt-to-assets ratios far above those that they (or their potential lenders) consider optimal in the new environment.

Holding constant the ownership-payment interaction, tax shield, and other variables correlated with ownership (such as bed size and teaching status), we find no differences in capital structure by ownership. This result persists in spite of the fact that the specific motives for holding debt are quite different across ownership.

Several other results suggest that capital structure decision making in the hospital industry resembles that in other sectors. If anything, the empirical results are more conclusive here. We note in particular our results on earnings volatility and tax shields. Bankruptcy risk matters, as does the tax advantage to debt under the U.S. corporate income tax.

Appendix A

Computation of $V_{y\alpha}$ for the Proprietary Case

The purpose of this Appendix is to show a formal computation of the term $V_{y\alpha}$ referred to in Section I, Subsection *A* of the text. In addition, the individual terms of $V_{y\alpha}$ are assigned a brief interpretation as discussed in the text.

Recall from equation (4) that the first-order condition, V_y, can be written as

$$\begin{aligned} V_y = & -L_y^M(1-t_b)kf(L^M)y^* + (F(L^M)-F(L^L))(1-k)(1-t_b)\tilde{\theta}_y \\ & + (F(L^H)-F(L^M))((1-t_b)-(1-t_s)(1-\tilde{\theta}_y)) \\ & + (1-F(L^H))((1-t_b)-(1-t_s)(1-t_c)(1-\tilde{\theta}_y)) \\ = & \ 0. \end{aligned} \tag{A1}$$

Differentiating (A1) with respect to α yields

$$\begin{aligned} V_{y\alpha} = & -L_{y\alpha}^M(1-t_b)kf(L^M)y^* \\ & - L_y^M(1-t_b)kf'(L^M)y^*L_\alpha^M \\ & - f(L^L)L_\alpha^L(1-k)(1-t_b)\tilde{\theta}_y \\ & + f(L^M)L_\alpha^M[(t_s-t_b-k(1-t_b))\tilde{\theta}_y + (t_b-t_s)] \\ & - f(L^H)L_\alpha^H t_c(1-t_s)(1-\tilde{\theta}_y) + (F(L^M) \\ & - F(L^L))(1-k)(1-t_b)\tilde{\theta}_{y\alpha} \\ & + (F(L^H)-F(L^M))((1-t_s)\tilde{\theta}_{y\alpha}) \\ & + (1-F(L^H))(1-t_s)(1-t_c)\tilde{\theta}_{y\alpha}, \end{aligned} \tag{A2}$$

where $L_{y\alpha}^M$, L_α^M, L_α^L, and L_α^H represent cross-partial and partial derivatives, respectively, of the various limits.

Discussion

The first two terms in (A2) represent the effects of third-party coverage on marginal bankruptcy risk referred to in Section I, Subsection *A*. Term (1) says that increased α increases the sensitivity of L^M to changes in y as reflected in the term $L_{y\alpha}^M$ $(L_{y\alpha}^M > 0)$.[15] Alpha discourages borrowing through this avenue. Term (2) says that increased cost-based payor reliance lowers the bankruptcy limit $(L_\alpha^M < 0)$. Assuming that $f(\cdot)$ is an increasing function at the bankruptcy point, this implies that cost-based payment makes the bankruptcy point less likely, inducing more borrowing.

Terms (4) and (5) on the right side of (A2) (skipping term (3) for now), represent the effects of cost-based payor dependence on the value of debt as a tax deduction. Term (4) says that cost-based dependence makes bankruptcy less likely $(L_\alpha^M < 0)$, which adds to the tax value of debt if $t_s > t_b$. Term (5), on the

[15] A sufficient condition for this sign is the plausible restriction $(\alpha - \alpha^2)\varepsilon_\alpha + \varepsilon < 1$. Calculations are available upon request from the authors.

other hand, captures the effect of α on changing the transition point between the second and third tax regimes. If α makes the third or high-income regime more likely (if $L^H_\alpha < 0$), then the tax value of debt is enhanced and borrowing is stimulated. As it stands, L^H_α is ambiguous.

Finally, terms (2), (6), (7), and (8) capture the effects of third-party payor dependence on the income value of debt. This is represented in terms of (6), (7), and (8) by $\tilde{\theta}_{y\alpha}$, which is almost certainly positive as long as r_b exceeds the return on equity paid by cost payors. In such a case, third-party payment enhances the income value of debt and leads to more borrowing. Finally, the second term on the right side of (A2) represents the fact that α increases the number of states of nature where positive income is realized. This also adds to the marginal value of debt through the term $\tilde{\theta}_y$, thus inducing more borrowing.

Appendix B

Effects of Cost-Based Dependence on NFP Capital Structure

The purpose of this Appendix is to compute formally the effects of third-party payor dependence on NFP optimal capital structure. A secondary purpose is to show that this effect is positive whenever the partial derivative of ε with respect to α is less than ε.

Recall that optimal leverage is implicitly given by (9), repeated here as

$$\alpha\left(- \frac{1}{r_b}(1 - \varepsilon)\right) + \frac{\delta}{r_b}(1 - \varepsilon) - 1 = 0. \tag{B1}$$

The effects of α on leverage can be computed by totally differentiating (B1) with respect to α and y. Since the total derivative with respect to y is assumed negative, the effect of α on leverage can be signed by simply differentiating (B1) with respect to α. Performing this differentiation yields

$$\left(1 - \frac{1}{r_b}(1 - \varepsilon)\right) + \frac{(\alpha - \delta)}{r_b}\varepsilon_\alpha + \frac{(\alpha - \delta)}{r_b^2}(1 - \varepsilon)\, r_{b\alpha} = \phi, \tag{B2}$$

where ϕ is the desired derivative. If $\phi > 0$, then it follows that α encourages leverage and vice versa.

Inspection of (B2) reveals that the first and third terms are unambiguously positive since $\delta > \alpha$ and $r_{b\alpha}$ can easily be shown to be negative. These two terms capture the positive influence of α on borrowing discussed in the text.

On the other hand, the term ε_α is ambiguous, calling the sign of (B2) into question. (Actual calculation of ε_α is tedious and cannot be signed; however, under reasonable assumptions, $\varepsilon_\alpha < \varepsilon$.) Inspection of (B2) shows, however, that if $\varepsilon_\alpha < \varepsilon$, then (B2) must be positive, meaning that cost-based dependence increases leverage.

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